THE

ELECTRICAL REVIEW.

VOL. LXV. AUGUST 27, 1909. No. 1,657.

ELECTRICAL REVIEW.

Vol. LXV.] CONTENTS: August 27, 1909. [No. 1,657.

	Page
Wear and Tear of Track	321
Rail Corrugation	322
The St. Petersburg Tramway Scheme	322
An Italian Tragedy	323
London's Electric Light Standards	323
Tariffs for Domestic Consumers (*illus.*)	323
Recent Progress in Arc Lighting (*illus.*)	324
Claudius Maximus	327
Correspondence:—	
Electric Miners' Lamps (*illus.*)	328
X-Ray Tubes	328
Samples with Tender	328
Testing Condensers for Leakage	329
Naval Voltages	329
Technical Classes wanted in the Daytime	329
Increased Output of Boilers	330
Automatic Transformer Switch	330
Magnetic Tests of Common and Silicon Steel	330
Income-Tax Assessment	331
New Electrical Devices, Fittings and Plant (*illus.*)	332
British Association Meeting at Winnipeg	333
Business Notes	337
Electrical Colliery Installation in Fifeshire (*illus.*)	339
The Electric Automobile	342
How to Charge for Electricity	343
Notes	347
City Notes	349
Electric Tramway and Railway Traffic Returns	350
Stocks and Shares	350
Share List of Electrical Companies	351
Exports and Imports of Electrical Goods during July, 1909	353
The Electrical Installation at the New Victoria and Albert Museum	354
Notes on Trade Abroad (*continued*)	355
Reviews	358
Foreign and Colonial Tariffs on Electrical Goods	360
New Patents Applied For, 1909	360
Published Specifications	360
Contractors' Column ... Advertisement pages 56 and 58	

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1909 EDITION

H. ALABASTER, GATEHOUSE & CO.

4, Ludgate Hill, London, E.C.

WEAR-AND-TEAR OF TRACK.

CARDIFF tramways have been very much in the public eye lately, chiefly because a certain section of the Committee thinks that it is more capable of managing the system than is the manager himself. A highly successful business for some years, these tramways have proved that they are not exempt from the common ills, and it has been evident for some time that meeting properly the depreciation and renewal charges will sop up the over-spill of profits which used to go to the relief of the rates.

The latest and the most grievous tribulation to afflict the Cardiff Tramway Department is disease of the track, and the reports of the manager, who is also the engineer, were so serious, and called for the expenditure of so much money in order to set things right, that a second opinion was demanded, and Mr. Howard Smith was instructed to examine and report. As one might suppose, his diagnosis and recommendations do not differ materially from those of Mr. Ellis, and it is only too clear that the track will be a heavy drag upon the progress of the tramways for some time to come.

None of the lines are 10 years old, and it may be said that the average age of the 30 miles is not more than 8 years, yet not only are the rails worn out, but a considerable portion of the "permanent"-way itself needs renewal. This is rather a blow—if any further killing were necessary—to the once-prevalent idea that the life of track under electric traction would be 15, 20, or even 25 years. The decrepitude of the earliest electric lines before the lowest of these figures was reached should have served as a check to the most sanguine promoter, especially when the comparatively light service on these pioneer lines was taken into account. Constructional methods have improved considerably since those days, but they seem to be only now on the point of overtaking the ever-increasing destructive effects of heavier service conditions.

It appears that the average density of car service over the Cardiff system is greater than that of any fairly comparable system in the kingdom, and corrugated rails have played a more than usually important part in the general decay of the track, while the boggy nature of the sub-soil in places, and the large number of sharp curves, have helped to produce the present state of affairs.

An article in the *Light Railway and Tramway Journal* of June 11th indicates a hopeful remedy for excessive rail wear, drawn from experience on the London underground railways. On the Circle sections the standard steam rail has worn in an astounding fashion under electric traction, a peculiar side wear being particularly noticeable. Rails in dry tunnels which under electric traction might have been expected to last five years have had to be removed in two years, and even in five months, while the life outside tunnels has dropped from an expectation of 12 years or more to a realisation of five years or less.

On the District Railway heavy side-cutting at curves has been experienced, and it was thought that this might be overcome by increasing the superelevation, but the results of experiments showed that the evil was intensified rather than diminished.

On both those lines rails with high silicon contents have raised the average life by 30 per cent. or more, and the use of a check rail much harder than the running rail has nearly eliminated side wear.

The specification of the rails, which are manufactured under the Sandberg patents and Bessemer process, is as follows :—

	District Railway.	Underground Railways of London.
	Per cent.	Per cent.
Silicon	·35 to ·45	·1 to ·2
Manganese (not to exceed) ...	·80	·8 to ·1
Phosphorus	·07	·07
Sulphur	·07	·075
Carbon	·45 to ·55	·5 to ·6

Mr. A. R. Cooper makes a most interesting addition to our knowledge of the causes of excessive wear on rails used under electric traction. This wear has been very marked on the Metropolitan and the District lines, which were converted from steam to electric traction without altering the characteristics of the permanent way; but the track of the tube lines was designed especially for electric service, and it is giving excellent results. We may remind our readers that the peculiar characteristic of Mr. Chapman's design lies in the sleepers being free to move vertically at the ends. Usually they are packed solid for their whole length, but on the underground electric railways the track really consists of a centre-bound road, the ends of the sleepers being supported by the initial packing only, and not beaten up, so that they depress some $\frac{3}{16}$ in. when trains pass over them. This spring in the track appears to counteract the punishment which the rails would otherwise receive.

On the Piccadilly Railway, which has a number of sharp curves, not a rail has been changed, or even turned, although in use for 2½ years, and there is none of that battering or corrugation on curves which has been such a nuisance on the District and other electrified railways.

In connection with the life of track it is germane to mention the scheme for determining the allowances to be granted for fair wear and tear on tramways, gas, water and electricity undertakings, which has been agreed upon, after long negotiation, between the Board of Inland Revenue and a special committee of the Tramways and Light Railways Association.

An abstract of this scheme appears in another part of this issue, and it is only necessary here to compliment the Association upon their work and its results.

The method of classifying permanent-way on the basis of average car-mileage per mile of track per annum, then saying that 16 years is the life of track used to the extent of under 50,000 car-miles per mile per annum, and so on, seems to be the best that could be adopted under the circumstances. Whether the life assumed in every class is not too long is a matter of opinion, and for the present we are inclined to think that it is.

In the case of overhead equipment on tramways, and of conduits on lighting systems, no allowance is to be made for depreciation, but the annual expenditure on repairs and renewals may be allowed as working expenses.

It is to be noted that this scheme has been drawn up for the sole purpose of income-tax assessment, for which it is necessary that allowance should be made for depreciation. Hitherto, we suppose, every undertaking has had to fight its own particular battle every year with Somerset House, but henceforth everyone knows where he is, and it is to be hoped that everyone is satisfied.

We do not gather that this agreement with the Inland Revenue will have any effect outside its direct purpose, but much use might be made of its provisions in making out the public balance-sheets of corporations and companies.

Rail Corrugation.

The *Official Circular* of the Tramways and Light Railways Association for July contains the translated discussion on Mr. A. Busse's paper bearing the above title.

It appears that every line of importance which contributes members to the Union Internationale and to the German Tramways Association has experienced corrugation, and the general opinion is that its appearance is connected closely with the introduction of electric traction. Many well-known Continental engineers joined in the discussion, but it will be sufficient to reproduce the concluding remarks of Herr M. Koehler (Berlin) :—

This discussion has had a singular effect upon me. Barely an hour ago I was fully convinced that we had at last got the microbe of corrugation tightly by the throat, and I was going to propose to have it christened "Petersenius." But this hope is shattered, and I am forced to regretfully acknowledge that the question remains unsolved. Many are the reputed causes, and we are not even able to apportion to each its proportionate degree of importance. Nothing remains, therefore, but to undertake renewed investigations. I move that the discussion be closed for the present, and I propose that the question be brought up again at our next congress. I further propose that the present members of the committee who have been at such great pains to place before us all known facts bearing on this question be invited to continue their labours in the interests of all concerned, and I look forward to our next congress with the assurance that they will by that time have reached more definite conclusions. (This was carried unanimously.)

The St. Petersburg Tramway Scheme.

A short time ago reference was made in this journal to electric tramway proposals submitted by international firms in regard to the network in St. Petersburg. It now turns out that a scheme was presented to the municipal council a few months ago by the Allgemeine Elektricitäts Gesellschaft, the Siemens & Halske Co., and the British Westinghouse Co., offering to take over the tramways hitherto laid by the municipal council, the generating station and the rolling stock, &c., for the sum of 20,000,000 roubles (£2,000,000). The companies also proposed to assume the obligation to extend the network by the expenditure of a further amount of £3,000,000. The scheme is said to be financially supported by the Deutsche Bank, the Belgian Société Générale and the British Westinghouse Co., and an agreement exists between the manufacturing firms so as to exclude mutual competition. It was recently reported from St. Petersburg that the negotiations between the interested firms and the municipal council would be resumed during August in view of the expected presence in the Russian capital of the responsible representatives of the council, and that the realisation of the scheme was highly probable, having regard to the circumstance that the city authorities were under the necessity of devoting a large expenditure to the improvement of the system of supply of potable water. An inquiry made in competent quarters in Berlin a day or two after the publication of the report elicited, however, a statement to the effect that nothing was known of the proposed resumption of negotiations in August, which was declared

to be an inappropriate month. It was added that the principles of the scheme have by no means been settled, but that it has now again become doubtful whether the companies will acquire the tramways from the city and work them. The possibility has to be reckoned with that the municipal council will retain the working in its own hands and also have the extensions carried out, in which case the companies in question would be taken into consideration. The main difficulty arises from the question as to the raising of the necessary capital, and it was this factor in the situation which formed the original motive for the suggested transfer of the undertaking to private enterprise.

An Italian Tragedy.

Last week that portion of the world which takes an interest in matters electrical was startled to hear of the terrible accident which occurred at the village of Oliginate, a township of 2,000 inhabitants on the left bank of the Adda River, a few miles south of Lecco, Lombardy. It appears, from the numerous newspaper reports, that during a furious thunderstorm some high-tension transmission wires broke, and, in falling, came into contact with low-pressure distributors, with the result, apparently, that in numerous instances the wiring and switches in the houses started to fuse and burn up. The wiring, evidently of the surface type, fell about the rooms, catching the inmates in its coils, with disastrous results, as from this and from attempts to use switches, a dozen people were killed outright and about 30 received severe shocks and burns.

It is significant that the casualties occurred almost exclusively in the houses of the lower classes, where the installations were evidently crude, and that in the better class villas no serious results occurred. The Orobia Electricity Co., of Lecco, whose circuits were concerned, supplies over a hundred villages round Como. In the absence of technical details, one can only conclude that the contempt bred of familiarity led to the neglect of what, in this country, would be regarded as elementary precautions; indeed, it is somewhat surprising and reassuring, if anything, when one considers the free-and-easy methods adopted in some parts of the Continent, that similar accidents have not occurred more frequently.

It is somewhat curious that not so many miles away—in Geneva, to be exact—a disastrous explosion occurred at the municipal gas works, on Monday afternoon, killing 13 men and injuring a great number of others, besides wrecking the property in the vicinity.

London's Electric Light Standards.

Our esteemed contemporary, the *Builder*, is much concerned as to the incongruities in design of the London electric light standards. Indeed, our friend has toured through certain main thoroughfares, note-book in hand, and emphasises its remarks by rough sketches of its pet aversions. Talking about arc lamp standards, our contemporary says "they are very much in want of a lift up out of the hands of the engineering ornamentalist"—but why "engineering ornamentalist"? Surely our contemporary is aware that many of these admittedly ugly standards are produced wholly and solely on the initiative of the municipal powers that be, the city architect, borough surveyor, civic council, &c.?

Moreover, we doubt whether the so-called engineering ornamentalist might not more accurately be classed as an architectural ornamentalist; certainly there is no engineering involved in designing a cast-iron lamp standard, and few engineers who have to pay for such things care for expensive and superfluous ornamentation, especially where this obstructs the light.

But even were the design of lamp standards in main streets left to qualified architects, with a view to their harmonising with their surroundings, what could the designer do in, say, Fleet Street, with its remarkable collection of architectural ugliness?

TARIFFS FOR DOMESTIC CONSUMERS.

By F. Fernie.

Perhaps the object of any municipal electricity supply scheme is to give a supply of electricity to the greatest possible number of people at the cheapest possible rate. The "maximum demand" system of charging divides the total costs of the supply amongst the consumers more equitably than any other system. Such a system, however, does not necessarily mean that the greatest possible number of consumers will be obtained, for if there are a certain number of consumers who will be obtained whether they are charged cost price or over cost price, it is obvious that, by charging these people above cost price, the station can afford to supply a certain number of people below cost price. There are thus three classes of consumers to be considered:—

1. People who will (unconsciously) pay more than cost price.
2. People who will pay exactly cost price.
3. People who can only be obtained as consumers by charging them under cost price.

The greatest possible number of consumers will be obtained by making Class 1 pay more than cost price, for then a proportion of Class 3 will also be obtained. Any tariff, then, that aims at obtaining the maximum number of consumers, must so balance things that the sum of consumers in Classes 1 and 3 is a maximum. The majority of the consumers connected to any undertaking belong to Classes 1 and 2, and if they properly realised matters, it is probable that all municipal supply tariffs would be on the maximum demand principle.

The overcharging of a proportion of the consumers would appear to be sound, only so long as the new undercharged consumers attracted were such as tended to improve the station load factor. In this way the all-round cost per unit would be lowered, so that Class 1 might eventually be charged a lower rate per unit than the original cost of supplying them. On the other hand, if the overcharging of some consumers attracted only such consumers as tended to lower the station load factor (*e.g.*, early closing shops), then the policy would appear to be unsound. The price of any manufactured article depends on the ratio $\frac{\text{fixed charges}}{\text{No. of articles made}}$. If a large sale depends on a low price, then any trading concern must sell at a loss at first in order to reach the large sale. It is possible that the metallic lamp difficulty could be counteracted in some cases by reducing the charge for power (heating, &c.) instead of increasing the charge made for lighting.

The cost of an electricity supply business may be divided into four parts:—

1. The "fixed" charges, which depend on the maximum demand on the station.
2. The "running" costs, which depend on the number of units sold.
3. The "service" costs, which depend on the number of consumers.
4. The "preparation costs," which depend on the load-factor.

The service costs include the interest, &c., charges on, and the maintenance of, the service cables, cut-outs, meters, &c.; all those parts of the salaries and office expenses which are connected with the reading and testing of meters, the preparation and collection of consumers' accounts; part of the management charges and preliminary expenses.

It may also be argued that part of the interest and sinking fund and the maintenance of the mains depend on the number of consumers. For the greater part of the cost of the mains depends on their length, and the length of mains laid varies with the number of consumers supplied (not necessarily so, but true in practice).

The maintenance of the mains depends entirely on their length, and the number of units lost in distribution partly on their length. The section of copper used depends on the maximum load, as well as upon the length. The whole cost of the mains cannot in any case depend entirely on the maximum load, since the cost of the trench work, the protection of the copper conductors, and the reinstatement of

roads, would be nearly the same whether the mains had to transmit 100 KW. or 1 KW.

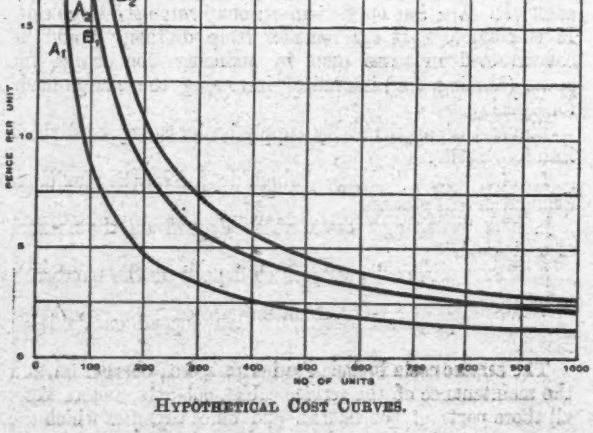
If it be admitted that half of the mains are true "service" costs, then the service cost per consumer will be quite a considerable amount. People who ought to be large consumers—those who live in comparatively big houses—involve a larger "service" cost than people living in smaller houses; for the length of mains necessary to supply a given number of consumers in a road depends on the frontage of the houses. Thus three houses, each with a frontage of 50 yards, require 150 yards of mains, whereas three small houses together, forming part of a row, might require only 30 yards of mains. The length of service leads would also be greater in many instances in the case of the larger houses. Against this must be set the ordinary commercial advantage of doing a large turnover with one customer instead of with a number.

On the "maximum demand" principle, consumers with similar load factors should pay at the same *rate* per unit, independently of the number of units actually used, but if the service cost per consumer be recognised as at all comparable in amount with the fixed charges per KW. of maximum demand, then the number of units used must be taken into account, and, of two consumers, the one who uses the largest number of units should be charged, on this account alone, at a lower rate per unit than the other.

Experience with the "maximum demand" system shows that nearly all domestic lighting consumers have very similar load factors; also, this system does not "slide" much when fairly reasonable load factors are reached, so that a flat rate per unit may fairly be applied to such a class. The unfairness of a flat rate occurs when it is applied both to this class *and* to very low load-factor consumers such as early closing shops and offices.

The effect of the diversity factor on the cost of supplying a consumer depends on what proportion the service charges bear to the total standing charges. The more standing charges that are put down as "service" charges the less will be the effect of the diversity factor.

The curve A_1 in the figure represents the cost per unit of supplying a consumer on the "maximum principle," with the



HYPOTHETICAL COST CURVES.

following assumptions:—Maximum demand of consumer = ½ KW.; cost per KW. of maximum demand (including service charges) = £10 per KW.; running cost = ½d. per unit; diversity factor = 1·5. B_1 represents the cost of supplying a consumer with a maximum demand of 1 KW. under the same conditions. For a 10 per cent. load factor the cost per unit is just under 2½d. A_2 (which coincides with B_1) and B_2 represent the cost per unit for the same consumers, if the cost per KW. of maximum demand were £5 and the cost per service £5 (the service cost is purposely exaggerated). The cost of supplying A with a load 10 per cent. load factor is now just over 4d. per unit, and B just under 3d. per unit. If a flat rate of 3½d. were in force, the B people would pay too much and the A people too little, and this would be quite reasonable if the average service costs of large consumers were greater than the service costs of small consumers, and if it is desirable to make some consumers pay too much for the common good. Of course, in the particular (exaggerated) case taken, anyone using less than 300 units would be hopelessly undercharged.

The service costs, in many special cases, can be made very small indeed, for small premises. If the average load factor of the class considered was found to be 10 per cent., the flat rate might be based on a load factor of 8 per cent., say; then B should pay just under 3½d. and A 5d. per unit. To bring this right for a 10 per cent. load factor, B should be charged 687 units at 4·2d. and 193 units at 1d., A should be charged 343 units at 4·2d. and 97 units at 1d. This would give an average price of 3½d. for 10 per cent. load factors. The number of units that any consumer had to use before getting the reduced price, might be made to depend on the rental of his house. By this method a consumer who did not use the average number of units of his class would (correctly) pay a higher rate for them, although his load factor might be the same as the average. Although the load factors of domestic consumers are very similar, yet the number of units used by similar houses is sometimes very different. Consumers who used more than the average would have the benefit of a correspondingly lower rate. It would be unlikely for any house to use more than the average number of units and yet have a much lower load factor than similar houses.

The difficulty of two rates and two meters for power and lighting would be overcome, if the reduced rate for lighting was made equal to the power rate. Some such method as this would have much the same advantages as that in force at Norwich, but it would be less harsh on those consumers who wished to make only a limited use of electricity. A consumer who was undercharged for his lighting would be overcharged for his heating, if he had any. The special wiring involved by the use of two meters is a very real drawback to the more extended use of domestic power appliances. The year might be made to start at the September quarter so that the heaviest bill would correspond with heaviest quarter's consumption.

RECENT PROGRESS IN ARC LIGHTING.

IN a lengthy article in the *E.T.Z.* for April 15th and 22nd, Dr. B. Monasch gives an interesting comparison, illustrated by recent tests, of the various types of arc lamps at present in use.

Up to about the year 1895, the only available arc lamp was the ordinary open one with vertically superposed pure carbons. The only advances made up to that time since 1879 were confined to improvements in mechanism and standardisation, leading to reduced cost. The price of a lamp in the eighties was about £17 10s., while the same type of lamp sells to-day at about £3. Series, shunt and differential lamps were in use, and the light obtained was white with a slightly blueish tinge. A 15-ampere lamp burning two in series on 110 volts, gave about 1,500 hemispheric Hefner C.P. without the globe, and used 18 or 20 mm. of carbon per hour, the specific consumption being about ·55 watt per hemispheric C.P. This type of lamp is still on the market, and even this year an order for 600 of them was given by a large Berlin establishment, chiefly because of the absence of injurious vapour and the whiteness of the light.

By careful design of the differential gear, it has now become possible to burn such lamps three in series on 110 volts without any starting or steadying resistance. The starting current may reach three times the normal value, but steady burning is attained in 30 seconds.

In 1895 the enclosed long-burning arcs introduced from America, came into competition with the open arc. The high cost of labour in America had led to the widespread use of the enclosed lamps, as they avoided the daily trimming required by the open arcs. The enclosed lamps burnt singly on 110 volts (70 or 80 volts on the lamp) for 150 hours, or, in extreme cases, for 350 hours with a single piece of carbon. The specific consumption, however, rose to about

1 watt per hemispherical candle-power with a clear glass inner globe and no outer globe. The greenish aureole present in the arc burning in air is absent in the enclosed arc, and the light is, therefore, blue or violet. The direction of maximum light emission is favourable to uniformity in street lighting, as it occurs only 10° or 20° below the horizon,

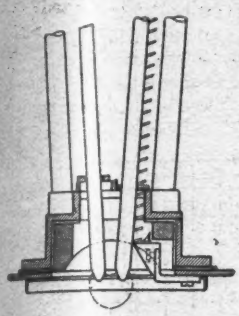


Fig. 1.

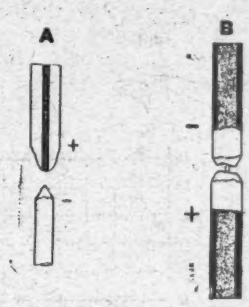


Fig. 2.

instead of about 45° to the horizon, as in the open lamps. In America the 4 or 6-ampere enclosed arc is consequently still in general use for street work.

The dense coating of the inner globe after, say, 200 hours, together with the dusty appearance of the outside, has, however, led to the intermediate type of lamp which, although enclosed, is fitted with thin carbons, which burn for about 22 hours only, but gives more light than the older enclosed arcs. The 6-ampere lamp of this type with 7 mm. carbons gives 1,100 hemispherical Hefner c.p., and the 5-ampere one with 6 mm. carbons gives 725 c.p. with a single clear glass globe.

The light is not so blue owing to the white heat attained by the thin carbon ends, and these thin carbons also give a much steadier light.

In 1900 Bremer came into the market with a lamp which opened a new era in arc lighting. He mixed various luminous salts, chiefly calcium fluoride, with the core of his carbons, and attained a great increase in light emission. The heavy deposit given off by these chemical carbons, prevented the old vertical carbon arrangement being employed any longer, and Bremer went back to an old 1880 type lamp with inclined carbons. Much trouble was found with the early chemical carbon or flame arc lamp, but in the course of a few years, the mass of experience collected by the various makers eventually led to a satisfactory lamp having a specific consumption of about ·15 watt per hemispherical Hefner candle-power, without globe, and taking 45-47 volts. The

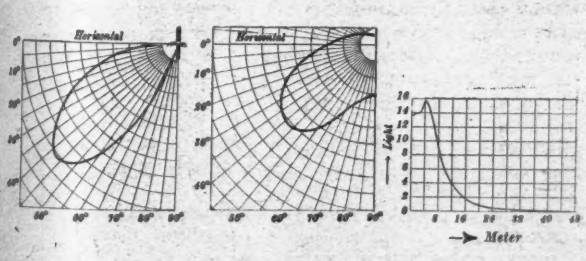


Fig. 3a.—Open Type Arc with Vertical Carbons, + 20 mm. and − 14 mm., without Globe. Hemispherical Hefner c.p. = 1,500. 15 Amps., 44 Volts.

Fig. 3b.—Open Type Arc with Vertical Carbons, + 20 mm. and − 14 mm., with Opaline Globe (20% loss). Hemispherical c.p. = 1,200. Spherical c.p. = 762. 15 Amps., 44 Volts.

Fig. 3c.—Curve of Illumination 1 m. from the Ground, in Lux, from the above Lamp suspended 8 metres from the Ground.

recent 20-ampere lamp of this type installed in some of the principal Berlin streets gave 5,050 hemispherical c.p., with clear-glass globe and white light carbons. By suitably ventilating the globes, the harmful effect of the white deposit given off by the carbons is minimised, both as regards the mechanism, and as regards the obscuring of the globe. The reduction in light from this cause, after burning for 18 hours, is under 5 per cent. Owing to the thin carbons which must be used for a steady light, exceptional lengths are required for these lamps, an 18-hour burning period requiring two carbons each 25 in. long.

Flame lamps using a special form of carbon, due to the Planiawerken, have recently been arranged for burning three in series on 110 volts or six on 220 volts, without starting or steadying resistance. The rush of current at starting reaches twice the normal value.

Most of the flame lamps in use employ a carefully designed and tested regulating gear, but in the earlier types so much trouble was caused in this mechanism by the white deposit given off, that Beck and others introduced simplified lamps without mechanism. Beck provides one of his carbons with

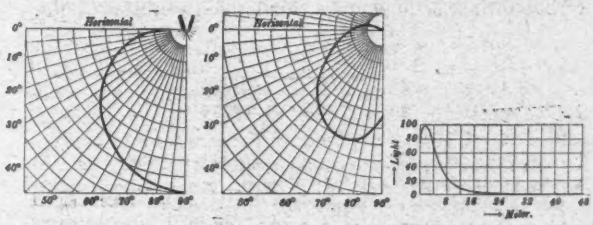


Fig. 4a.—Flame Arc with Inclined Carbons, + 11 mm. and − 10 mm., without Globe. Hemispherical Hefner c.p = 4,100. 15 Amps., 47 Volts.

Fig. 4b.—Flame Arc with Inclined Carbons + 11 mm. and − 10 mm., with Opaline Globe. Hemispherical c.p. = 3,380. Spherical c.p. = 1,915. 15 Amps., 47 Volts.

Fig. 4c.—Curve of Illumination 1 m. from Ground. Lamp 8 m. from Ground.

a thin rib of carbon all along its length. This rib rests on a shoulder and gradually, owing to the heat of the arc near it, it consumes away and lets the carbon drop, and, since the two carbons are geared together, the feeding of the arc is thus effected.

Janecek builds a lamp on the principle shown in fig. 1. An iron strip, out of which teeth have been stamped, is let into the anode carbon. The teeth rest in turn on the porcelain projection A, and as they become heated by the arc they

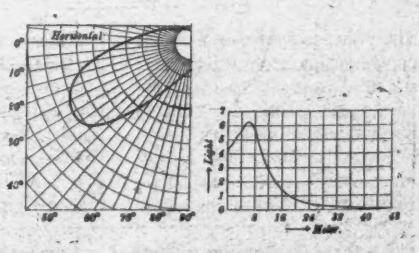


Fig. 5a.—Enclosed Arc Lamp with Clear Glass Inner Globe and Opaline Outer Globe (30% loss). Hours of Burning = 110. Carbons = 13 mm. for both + and −. Hemispherical c.p. = 500. Spherical c.p. = 511. 7½ Amps., 80 Volts.

Fig. 5b.—Curve of Illumination 1 m. from Ground. Lamp 8 m. from Ground.

bend back and allow the carbon to fall gradually until the next tooth, which is still stiff and straight, reaches A and the process repeats itself.

For working two lamps in series on 110 volts, a Nernst-type iron-wire resistance in hydrogen is employed as steadying resistance.

In general, however, these lamps without regulating mechanism must be considered as falling short in quality of those with the mechanism. They are too much dependent on the physical qualities of the carbon ribs, &c., to be selected in cases where reliability of action and constancy of light are of importance, even although they are naturally somewhat less expensive.

After flame lamps had come into widespread use, T. L. Carbone introduced pure carbon lamps with inclined carbons taking 75 to 80 volts. These stood between the ordinary pure carbon open arc and the enclosed arc. The hours of burning were only slightly in excess of those of flame arcs, so that no great demand for this lamp existed.

The next advance was made by Blondel who employs vertical carbons with special chemical treatment which gives the economy of the flame arc coupled with considerably increased hours of burning.

Blondel's carbons are distinguished from ordinary flame carbons by having a much greater proportion ($\frac{2}{3}$ in place $\frac{1}{3}$) of core diameter to outer diameter of carbon, as shown in fig. 2, where A shows the proportion of flame arc carbon and B shows Blondel's carbon. By this means the arc is always formed on the core substance instead of jumping to the pure carbon shell sometimes and so leading to an unsteady light.

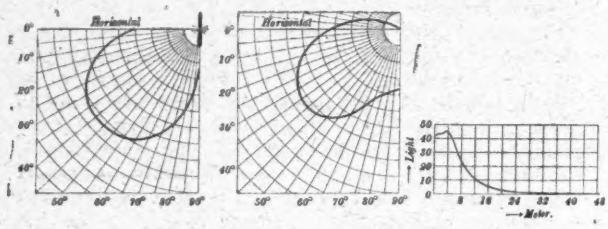


FIG. 6A.—BLONDEL ARC LAMP WITH "T. B." CARBONS, + 20 MM. AND — 18 MM. IN DIAMETER, WITHOUT GLOBE. HEMISPHERICAL C.P. = 4,100. 15 AMPS, 40 VOLTS.

FIG. 6B.—BLONDEL ARC LAMP WITH "T. B." CARBONS + 20 MM. AND — 18 MM. IN DIAMETER, WITH OPALINE GLOBE. HEMISPHERICAL C.P. = 3,520. SPHERICAL C.P. = 2,090.

FIG. 6C.—CURVE OF ILLUMINATION 1 M. FROM GROUND. LAMP 8 M. FROM GROUND.

The Blondel arcs are arranged for 30 to 40 volts and can be burnt 2 or 3 in series with a small steadying resistance on 110 volts. The vertical arrangement of the carbons allows greater diameters to be used than in inclined carbon lamps. The 15-ampere lamp with a 20-mm. upper and 18 mm. lower carbon burns for 22 to 24 hours with a length of each rod of 12½ in. For the sake of comparison, Dr. Monasch gives a series of candle-power and illumination curves for lamps of the various types, each including steadying resistance, consuming 825 watts, *i.e.*, the same consumption as the ordinary open type direct-current 15-ampere arc burning two in series on 110 volts.

In fig. 7 the curves of illumination 1 metre above the ground are shown for these various lamps (with opaline globes) on the assumption that they are suspended 8 m. from the ground and 60 metres apart.

Curve I is for the flame arc, the max. illumination is 98·9 lux, the minimum is ·8 lux, and the average* is 6·96 lux, so that the irregularity factor, $\frac{\text{max.-min.}}{\text{average}}$, is 14·1. The consumption for 1 lux average* illumination is 119 watts.

Curve II is for the Blondel arc with "T. B." carbons. The max., min. and average illuminations are 45·3, 1·6 and 6·8 lux. The irregularity factor is 6·4, and the energy consumption per average lux is 121 watts.

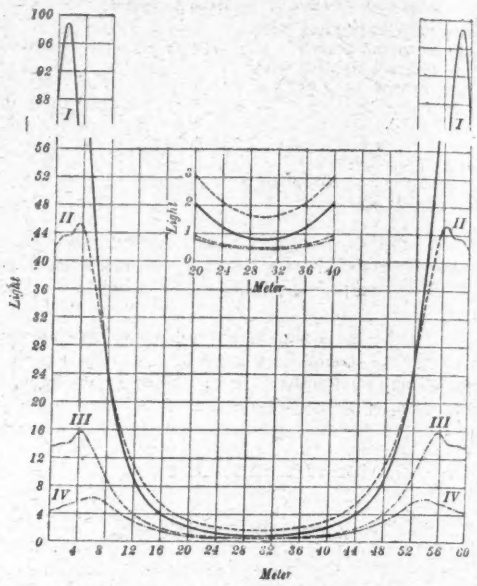


FIG. 7.—ILLUMINATION CURVES FOR LAMPS, 8 M. ABOVE GROUND AND 60 M. APART.

Curve III is for the ordinary open arc lamp with vertical carbons. The max., min. and average illuminations are 15·7, ·5 and 2·3 lux. The irregularity factor is 6·4, and the energy consumption is 353 watts per average lux.

Curve IV is for the enclosed arc. The max., min. and average illuminations are 6·3, ·45 and 1·5 lux. The irregularity factor is 3·9.

The energy consumption is 550 watts per average lux.

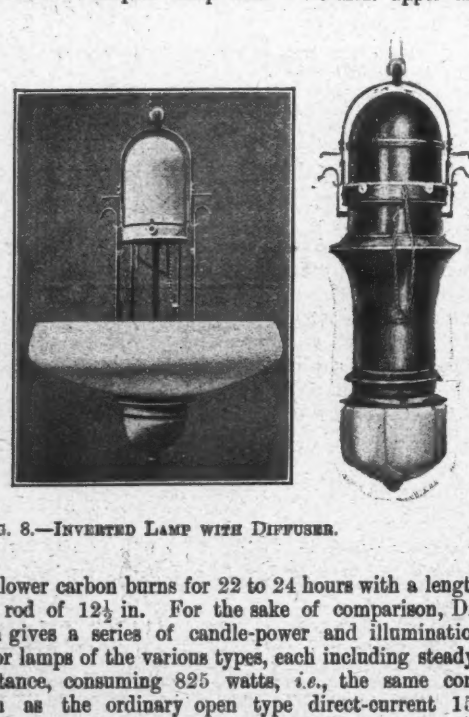


FIG. 8.—INVERTED LAMP WITH DIFFUSER.

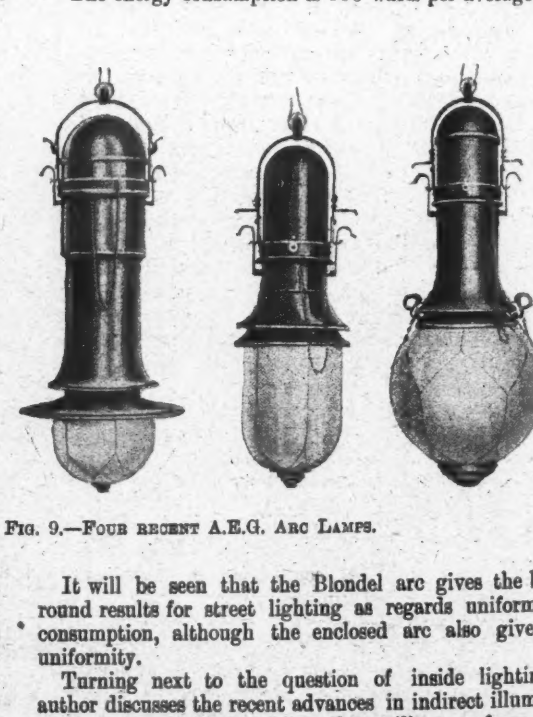


FIG. 9.—FOUR RECENT A.E.G. ARC LAMPS.

It will be seen that the Blondel arc gives the best all-round results for street lighting as regards uniformity and consumption, although the enclosed arc also gives good uniformity.

Turning next to the question of inside lighting, the author discusses the recent advances in indirect illumination by means of reflection from the ceiling or from special reflectors, with inverted lamps. In some cases good results

* In these curves the "average illumination" has been taken as the height of a cylinder whose developed surface is of the same area and same base length as the actual curve of illumination.

are obtained with semi-indirect lighting, using inverted lamps, but letting some of the light fall through a strongly diffusing glass globe, whilst the rest is reflected from the ceiling (fig. 8).

The following results have been obtained by the author and Dr. L. Bloch :—

Arrangement of lamps.	Average illumination in lux 1 metre above the ground.	Watts consumption per average lux and per 100 sq. metres of floor space.
Quite indirect lighting with the + carbon below ...	80 to 100	12 to 22
Quite indirect lighting with the carbons as usual (+ carbon above)	50 to 70	18 to 30
Semi-indirect lighting ...	30 to 60	15 to 35
Ordinary direct lighting ...	60 to 70	16 to 25
Nernst lamp lighting ...	56	44
Carbon-filament incandescent lamp lighting ...	40	80

The best results as regards energy consumption can thus be equalled by quite indirect lighting, but care must be taken to maintain the reflecting surfaces in a clean and efficient condition.

In conclusion, the author refers to the gradual suppression of the highly ornamented arc lamp by the more simple and serviceable modern designs. In fig. 9 are shown four recent simplified designs of the A.E.G.

CLAUDIUS MAXIMUS.

By A. K.

"From Claudius Maximus, in all things to endeavour to have power of myself, and in nothing to be carried about; to be cheerful and courageous in all sudden chances and accidents, as in sicknesses: to love mildness and moderation and gravity: and to do my business, whatsoever it be, thoroughly, and without querulousness. Whatsoever he said, all men believed him that as he spake, so he thought, and whatsoever he did, that he did it with a good intent. His manner was never to wonder at anything; never to be in haste, and yet never slow: nor to be perplexed, or dejected, or at any time unseemly, or excessively to laugh: nor to be angry, or suspicious, but ever ready to do good, and to forgive, and to speak truth; and all this, as one that seemed rather of himself to have been straight and right, than ever to have been rectified or redressed; neither was there any man that ever thought himself undervalued by him, or that could find in his heart, to think himself a better man than he. He would also be very pleasant and gracious."

Thus writes Marcus Aurelius, in recording "What, and of whom, whether Parents, Friends, or Masters; by their good examples, or good advice and counsel, he had learned."

I suppose Claudius Maximus was an ancient Roman. I know a modern Englishman, an electrical engineer, whom I regard as possessing the characteristics mentioned in the eulogium written by Marcus Aurelius, which I have quoted. He has gone to be a prince in his own right, and the place that knew him is filled by another.

The type and number of the applicants for his vacant chair is evidence that the supply of good men is still greater than the demand for them. I discussed this matter last October in this paper, and endeavoured to show that there is an alternation between good times and bad, which causes conditions such as those which obtain at present to recur periodically. Those of us who have been able to get into positions in which we can wait comfortably for opportunities, have much cause for thankfulness at our good fortune. Even if we sometimes feel a bit "groovy," rather sick of things, perhaps not least sick of ourselves, we may, I think, take comfort in this reflection that things have been getting worse and worse for so long, that there must be an improvement soon. The influx of new men from the colleges is less, and, as I said before, this in itself will cause in time a lessening in the number of men available. To point out that there is need for very great patience on the part of those deciding to enter the electrical profession is not to strike a severer note (to adopt the phraseology of your correspondent "Interested," who might, I sometimes think, sign himself "Interesting" instead) than is warranted by the facts of the case. Nobody who is familiar with these facts will deny that the profession is full of good men who find the utmost difficulty in moving. I have seen with satisfaction the transfer of the correspondence tuition advertisements to a position apart from the "Situations Vacant" in this paper. I foretell, further, a reduction in their number. Things which decrease the import of new goods, or new men, must eventually result in a raising of the prices of goods, or men, already in the market.

If I continue to write in this strain some will think I am a Protectionist. That would not be true. I merely desire to improve the quality of the dumped goods, and to prohibit entirely the importation of the useless and unfit. That the outlook is rather dull just now I admit, but that it is threatening to become worse, I deny completely. Those who think a sort of glorified trade unionism is necessary before improvement can result have mistaken the hour of the night; it is already morning.

One cause of bad conditions is to be found, I think, in the fact that so many electricity committees and similar bodies, who are the customers for the abilities and knowledge we have to sell, do not really possess the ability themselves to choose their goods. Those who go to make up the heterogeneous company composing these gatherings must know in their own hearts, if they will but give themselves two pennyworth of honesty, that they are not the right people to run an electricity undertaking. Knowing this, it is too frequently the case that they retire within the walls of their pride, and decline to adopt the well-reasoned advice offered them, in order to show their authority. In such circumstances very few men can afford to take the heroic course of resigning an appointment held under such very unsatisfactory conditions.

Raise the quality, then, and weed out the undesirables, and conditions will improve. Pay will become better, and the market will become brisk once more. Then the influx of men will begin again, but I hope that by that time we shall have some qualification test, without which no man will be able to call himself an electrical engineer, so that conditions could never again become as bad as they are now, and have been for some time past.

We must begin soon to rise on our curve, and try to decrease its amplitude. In the words of a poet who desires to remain anonymous :—

> No straight-line law thy varied moods obey
> Nor simple sinusoidal, so I find—
> The logarithmic decrement must play
> A leading part
> Within thy heart,
> Or soul, or mind.

He was addressing an English May, which had been uncommonly offensive at the beginning, but was improving, as June approached, to steadier weather conditions. *Mutatis mutandis* we may address the verse to the Presiding Genius of our profession, who directs electrical destinies.

Meanwhile, we must, like Claudius Maximus, "be cheerful and courageous," "never wonder at anything," and "be pleasant and gracious." That, in itself, will tend to improve each one of us, and in time the improvement we make in ourselves, will spread to others, raising the general quality in the manner which I have shown to be so desirable.

Copper.—Despite the predictions of the pessimist, visible supplies continue to increase and the hitherto absurd figure of 100,000 tons seems almost within sight. Messrs. Merton's mid-monthly return shows 80,852 tons, of which 67,455 tons are actually in the United Kingdom. Analysed figures give American supplies rather lower, Spain 1,373, or higher for mid-month, Australia about average, Chile lower; in general, as one might expect, there is a less brisk intake owing to the large stocks. So far, however, there are no re-shipments to the States.

The Selfridge Installation.—In connection with this matter, to which we referred last week, the Synchronome Co. inform us that their original installation of 19 clocks has now been extended to 34.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

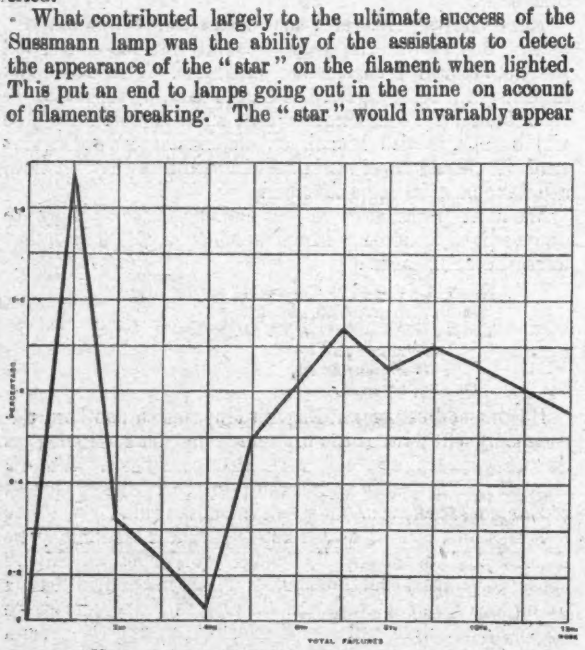
Electric Miners' Lamps.

Mr. F. Pritchard, of Messrs. Ellis & Ward, electrical engineers, Birmingham, recently brought to my notice an article on electrical miners' lamps, read by my late principal and tutor, Mr. S. F. Walker, before the Institution of Electrical Engineers in 1901.

It may appear not a little strange to rake up a subject dating so far back, but in view of the greater possibilities which the metallic-filament lamp has created, I am of opinion that one or two amendments to Mr. Walker's paper, and a few additional details of the working of the Sussmann lamp, would be of value to those interested in this branch of the electrical industry. Having been connected with the Sussmann Lamp Co., I took part in the working of a plant of 600 electric lamps at Merton Colliery, County Durham. I also installed a plant consisting of 300 lamps at another colliery, belonging, I believe, to the Durham Joicey group, situated at Fence Houses, in the same county, and later put down an experimental plant at Hyde Colliery, near Manchester.

At the outset, the results at Merton Colliery were very bad, the failures being nearer 30 per cent. than 4·25 per cent., as given in Mr. Walker's paper. The failures were chiefly from battery troubles, due to defective positives, carelessly made and dirty connections. The next source of difficulty was the bulb item. The lamp used was eventually given up in favour of the French James lamp, which averaged 800 hours' life. In fact, the James lamp was so successful, that at Fence Houses no other make was tried.

What contributed largely to the ultimate success of the Sussmann lamp was the ability of the assistants to detect the appearance of the "star" on the filament when lighted. This put an end to lamps going out in the mine on account of filaments breaking. The "star" would invariably appear



Miners' Lamp Failures During 12 Weeks.

on the filament about 10 to 20 hours before the breaking point had been reached, when the bulb would be replaced by a new one, thus avoiding the chance of its breaking during working time.

The intensity of light along the "unstarred" part of the filament was, of course, less than on the "starred" portion, which was caused by a particle of carbon having become disintegrated. Another item of importance was the adoption of acidulated water to replace loss in the cells from evaporation, bubbling over when on charge and other causes, instead of plain water, the trouble being, in the case of plain water, over dilution of the electrolyte. The cells, it must be borne in mind, were entirely enclosed save for vent holes, and being made of ebonite, the plates were out of view. After some six months, results were favourable, the percentage of failures from all causes having fallen to about 5 per cent., and later, in the light of further experience, results rapidly improved.

At this time I proceeded to install a plant of 300 lamps at Fence Houses, and these were highly successful. In fact, I was informed by the management that the question of installing electric miner's lamps throughout the whole of the collieries belonging to the group was under discussion. I enclose curve showing the results of 12 weeks' working, the curve indicating the percentage of failures from all causes. The adoption of metallic filaments would mean increased efficiency, and a lighter accumulator could be used.

The Sussmann lamp is by far the most useful pattern on the market. Suitable for the miner in many ways, it is equally adapted for rapid manipulation when being given out to the men, or when being received at the end of the shifts, when the battery has to be taken out, the case and lamp glass cleaned and placed in its position on a rack, and all the batteries charged, as fast as the miners come out of the mine. The locking arrangements, by means of lead rivets, leave little to be desired in practice. The miners will not have internal reflectors, and any lamp which does not illuminate all round will not be successful.

To protect the lights from the eyes of miners when walking in and out, or around about the mine, a tin shield is used. The Sussmann Company were compelled, under pressure from the miners' representatives, to remove the internal reflector from the lamp.

Under modern conditions, there should not be the slightest difficulty in making electrical miners' lamps a commercial success, with failures on an average not exceeding ½ per cent. The lamps could be run for less than 4½d. per lamp per week in installations of 300, while for installations of 600 lamps more favourable rates could be obtained.

Positives of the Planté type should be used, with Faure negatives; also with metallic filaments, lamps to run at 3·9 volts with detachable reflectors fitted on case. The Sussmann lamp could be made highly successful under these conditions, and would weigh less than when designed for carbon filaments.

With regard to gas-detecting apparatus, I am convinced this would be of little service, and as for primary battery electric miners' lamps, I feel bound to express the opinion that they would prove impracticable in working on a large scale.

Giraldus Jones.

Birmingham, *August 18th*, 1909.

X-Ray Tubes.

The query of your correspondent "Jacey" could be replied to more intelligently if there were some indication given as to the contents of his vacuum chamber, and the action taking place therein, when his apparatus is in operation.

His letter suggests that he is working at something in the nature of a Geissler tube, and in such apparatus he will find that it is practically impossible to maintain a constant degree of vacuum, probably owing to the ionising action associated with the discharge between the electrodes which, theoretically should, and does, tend to increase the degree of vacuum.

Does "Jacey" wish to use leading-in wires, and if so, what current must they be capable of carrying?

C. Orme Bastian.

August 18th, 1909.

Samples with Tender.

We also are glad to note that the very unreasonable requirements of the Swansea arc lamp specification are being aired in your "Correspondence" columns. We most certainly should not have applied for the specification and paid our deposit had we known beforehand that eight lamps had to be sent as samples *with the tender*, and looking at the matter from the point of view of the whole of the electrical trade, it is almost certain that the cost to th

various manufacturers who tendered was more than the profit (if any) which will be made on the order. Each tenderer had to submit eight special lamps (and the "must" was emphasised in the specification), including carbons, cut-outs, &c. As detailed by "Another of the Tenderers," they had to bear the cost of carriage *both ways*, and in our case one of the lamps was returned in pieces, one or two globes were broken, and every lamp will have to be done up before being sent out again.

It seems to us that Mr. Prusmann makes out a very poor case indeed in his letter, it being a plaintive kind of epistle, saying "Please, sir, I did it for their good and now they rate at me." If Mr. Prusmann had specified that two or three of the lowest tenderers would have to send samples, and that these would have to be approved by him before the order was placed, we do not think any firm would have grumbled; but the electrical trade does not live on losses (what does it live on?), and the Swansea arc lamp order has been a loss to the trade as a whole.

A Third Tenderer.

August 20th, 1909.

Testing Condensers for Leakage.

I have been much interested by the correspondence on this subject, partly, perhaps, because "Harbee's" method was substantially given in a paper on "Water-tube Boilers"—written by myself about two years ago—but chiefly because the problem stated by Mr. Middleton is one to which I was compelled to devote serious attention at that time, and which I think I may claim to have solved.

Like him, I have condensers under my charge which draw their circulating water from a salt supply. Up to two years ago I had experienced considerable trouble with leaky tubes which were apt to start leaking at any moment, and would quickly pass enough salt into the feed water to cause very serious priming. I had for some years used the silver nitrate test two or three times on every shift, but this involved considerable trouble and was besides insufficient, as I found that in bad cases enough salt could be passed into the system in half an hour to give rise to priming, which, among other things, necessitated washing out all the boilers on the line.

This being so, it was essential to devise an automatic method of instant detection of leakage, and I at length perfected an apparatus which will detect any such within two or three minutes of starting, and which can be adjusted to show any desired degree of leakage from 1 grain per gallon upwards. I have had it in continual operation for about 18 months, and it has never failed.

I may say this has been taken up and will shortly be put on the market by one of the best known firms of steam and fuel specialists.

R. Somerville Bayntun, A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E.

Birkenhead, *August 23rd*, 1909.

Naval Voltages.

A correspondent, writing under the initials "H. P. B.," in severely criticising an article entitled "Naval Voltages," has allowed his indignation at what he considers an insult to shipbuilding firms and Admiralty staffs alike, to carry him rather wide of the point.

As a matter of fact, the letter, which is a rough summary of the electrical equipment of one of our latest battleships, has very little bearing upon the article in question, which has for its subject matter the gradual growth of electricity in the Navy from the time when its principal use was to run the searchlight. Why the contributor's knowledge of modern ships and modern electrical matters should be so vigorously attacked is not quite clear, unless it be in order to provide an excuse for putting forward "H. P. B.'s" own knowledge of the electrical equipment of the very latest type of battleship. To imagine that the majority of ships in the Navy at the present time are built upon the lines of the latest type, is quite an erroneous view.

As a matter of fact, the letter describes the electrical equipment of the Navy as it may be expected to be in a few years' time, when the 80-volt ships have gone to the scrap-heap. The reader who wishes to see matters as they really are would scarcely be content to visit the latest "show" ship in the Fleet without also going on board other types which stand in the majority.

Here he would find that the standard of 80 volts predominated; that only in the latest types were twin searchlights fitted; that the searchlight equipment was what "H. P. B." seems to consider about 20 years stale; that the goodly number of arcs reduced itself down to two for general purposes and four temporarily rigged on such occasions as coaling ship at night. Batteries he would find largely in use for communication purposes. He would learn that wireless telegraphy had been in use in 80-volt ships long before the higher standard of voltage had appeared, and if he took the trouble to inquire in the dockyards, he would learn that the voltage still remained at 80 in the great majority of ships, but had taken a sudden leap in the later types, and had not risen by gradual stages at all. Doubtless the new standard was not fixed without due consideration of its advantages, and it can hardly be seriously imagined that it would be chosen in any haphazard manner.

Altogether, "H. P. B." seems to have gone out of his way to interpret the article into an attack upon Naval progress in electrical matters, and in order to strengthen his criticism, has found it necessary to employ personal invective, which in itself is not a logical form of argument.

The Writer of the Article.

Technical Classes Wanted in the Daytime.

Replying to your correspondent Mr. Brazier, I have for some years been attending evening classes, but, owing to being on "shift" work, have had extreme difficulty in keeping pace with other students, due to unavoidable absence every third week.

I know of many "shift" men who would welcome any arrangement whereby they could attend *regular* classes.

Esdaile Wyatt.

August 20th, 1909.

I am glad to see that such an influential journal as the ELECTRICAL REVIEW is willing to take this matter up seriously. We hear of the educational authorities speaking of compulsory continuation classes, and the essentiality of technical education in all trades; we are told, and rightly so, too, that Germany's success and advancement is not due to her big army or her navy, but due to her advancement in technical education. This being so, I think that the governing bodies of the several colleges in London should come up to the scratch and show their earnestness to give every facility to those who are anxious to receive technical education, but who are handicapped owing to the nature of their work.

In my opinion, it is hardly probable that all obstacles which confront the "shift" worker can be entirely removed. For instance, there are three shifts—morning, evening and night shift; now, assume that these classes are held from, say, 9 a.m. till 12 noon, it is quite obvious that one of the "shifts" will be absent once every week, which means that a student could only attend two weeks out of three.

To make these classes anything like a success, the courses would have to be graduated similar to the present day and evening classes, as an elementary student would not benefit much by taking an advanced course, and likewise an advanced student could not be expected to take an elementary course. At first sight this may appear of necessity to incur a great additional expense on the governing bodies of the different colleges. But I suggest that these (shift) day students could attend the lectures given to the present day students, according to the particular course or class they proposed to take; this would eliminate the necessity of employing additional teachers. I feel sure, if the governing bodies carefully studied the courses (times of lectures, &c.) they offered, there would be a great number of men, who are at present handicapped, avail themselves of this opportunity.

J. W. Houghton.

August 23rd, 1909.

Increased Output of Boilers.

Referring to Mr. Embury McLean's letter, it is not clear how his method of fitting an automatic damper regulator to baffle the gases from boilers using forced draught can increase the output of boilers. On referring to my copy of the *Proceedings* of the American Society of Mechanical Engineers in December, 1906, I see that Mr. McLean gave several instances where boilers burning soft coal with natural draught showed increased duty and a money-saving when burning the cheaper fuel, rice or buckwheat anthracite, with forced draught; also that Prof. Kent then said :—

I find here Mr. Embury McLean's discussion on balanced draught. I do not think it is a fair test to take an ordinary boiler and get a very low result, far below what one ought to get with that boiler in the usual conditions of everyday practice, and then publish that result in comparison with a fairly good result obtained from the same boiler when fitted with some patented appliance, claiming that the apparent saving in fuel is due to the use of that appliance.

Mr. McLean's last letter says nothing about changing from soft to hard coal; but in the instance he gives, of boilers formerly evaporating 3 to 4 lb. and now evaporating 7 to 8 lb. water per square foot of heating surface, it is noteworthy that the ratio of heating surface to grate surface is as low as 40 to 1.

It is obviously just as easy to get 8 lb. evaporation on the 40 to 1 ratio as to get 4 lb. evaporation on boilers with a ratio of 80 to 1, or to get 6 lb. with a ratio of 60 to 1; the identical fuel would be burnt in each case on the identical furnace.

No evidence is given of the claim of 15 to 16 per cent. of CO_2 in flue gases, but it is common knowledge that such a result is only possible with regular mechanical firing as well as correctly regulated draught and a good mixing method. Any attempt to cut down the air so near the theoretical minimum, with intermittent hand firing on grates, inevitably involves fuel being wastefully burnt to CO through deficiency of air when firing.

Balanced draught, using two fans, has been used for many years, and it is credibly claimed that air leakage with forced and induced draught combined is less than with induced draught alone.

But with forced draught, correctly applied, nothing can be gained by throttling the exit gases by an automatic damper regulator; there is no occasion for retarding the free outflow of gases (as Mr. McLean admits in the case of Lancashire boilers). It is doubtful if it is worth removing the ordinary baffles of a water-tube boiler, if this necessitates throttling the exit gases at the damper, with the risk of back-draughts if the automatic device gets out of order.

Regulation of draught alone, as advocated by Mr. McLean, is no substitute for correct regulation of fuel and air together, and the latter method is widely used both in Europe and America.

Scrutator.

Automatic Transformer Switch.

Your correspondents, "Engineer" and "Climax," seem agreed that the automatic transformer switch is designed to overcome the defects in bad transformers and inaccurate supply meters. If this be the case, surely it would be better to get at the root of the evil.

In the article it was not suggested that 4d. per unit was an average price for current. An examination of the "Electrical Review List of Supply Works" will show that it is impossible to get at the average price paid for current in the United Kingdom. Even did we know the figure it would be useless; for every proposed installation of an automatic switch must be judged on its own merits and circumstances.

"Engineer" apparently infers that a "glazed front" has been put in some switches, as their indifferent working is anticipated. It should be pointed out that an auto-switch must work perfectly.

Time alone will show whether manufacturers are able to produce an apparatus at a low price which will work with absolute reliability with so small a current; for unlike a clock, supply meter or similar apparatus, the switch has an appreciable amount of work to do.

If the switch is perfect, it is useful; if anything from perfect, it is useless. A single failure of a switch in the majority of cases would be sufficient to condemn it for all time.

The calculations of "Climax" are based on transformers of over 1 KW., whereas the view taken in the article, and to a certain degree upheld by "Engineer," is that there is little or no demand for an auto-switch for a transformer of more than 1 KW.; also, in an installation of the order of 3 KW., the lighting hours will probably be entirely different to the ordinary private house or small shop lighting hours.

As explained in the article, the mere fact of "Climax's" lamp having lighted does not prove that the transformer switch has "spoken." The effect of burglars, illness, or fire, also mentioned by "Climax," would certainly be very interesting, but it is extremely doubtful whether instant light would ameliorate matters.

The transformer, unfortunately, is a necessary evil. Will the addition of a delicate and somewhat complicated apparatus neutralise this? Two wrongs do not always make a right.

Student.

I have read with much interest "Student's" letter *re* the above, and the criticisms of "Engineer" and "Climax," and the figures they quote seem to prove conclusively that automatic switches have the advantage over "all-day" open-circuit losses, provided the former are reliable. My own experience does not prove in their favour, but I certainly think that the troubles which are usually met with in new electrical contrivances will soon be overcome.

I would like to point out, however, that the figures quoted for transformers are abnormally high. For instance, 500-watt coils are shown as having an open-circuit loss of 15 watts actual, the makers' figures being 10. Now these figures are ridiculous, and show that the writers are not conversant with the *present* market; 12 months ago the losses stated would have been about right.

Nowadays you can buy an auto-transformer for 500 watts for 27s., with a no-load loss of 5 to 6 watts, and this is guaranteed and never exceeded. I have assumed the ratio to be 4 to 1 up to 250 volts primary, periodicity 50. Of course, at 2 to 1 the output for same loss would be 750 watts. Also, you can buy 3,000-watt transformers for 50s. to 55s. with a 25-watt iron loss (2 to 1).

These figures (which I am prepared to stand by) will put a different complexion on the matter, and, I think, help the case for auto-transformers.

"Engineer" remarks that the ordinary house meter will often read 50 per cent. fast with a small amount of energy passing, but I know for a fact that a lot of meters now installed will not "start up" at all, although I would not like to give this as an argument in favour of

Iron Losses.

Inquirer "J. W. G." has not sent his name and address.

MAGNETIC TESTS OF COMMON AND SILICON STEEL.*

A CIRCULAR issued under the date of June 1st by the Bureau of Standards, Washington, on the subject of magnetic testing, sets forth the scope of the Bureau in this line of work, and includes a description of the methods employed and a schedule of fees. Two tables are printed in the circular which give the results of the magnetic tests of ordinary steel and of silicon steel. It is pointed out that ordinary sheet steel in common use varies very widely in its magnetic qualities, and that the quality is not closely related to the cost. While the watt loss when tested with alternating current varies in the case of ordinary steel from 1·25 to 2·36 watts per pound for sheets of No. 29 gauge, at a frequency of 60 cycles and a magnetic induction of 10,000 gausses, silicon steel varies only from 0·66 to 1 watt per pound under the same conditions. In addition to this variarion, there is a great difference in the constancy of magnetic properties with time. Some metals

* N.Y. *Electrical World.*

show very decided ageing, which in one case amounted to as much as 67 per cent. in 500 hours; other specimens, including most silicon steels, show little or no variation with use.

As to the commercial significance of the tests, the design of a 5-KW. transformer is taken for an illustration. If, instead of material showing a core loss of 45 watts, another showing a core loss of 32·2 watts is taken, the saving in operation for 8 760 hours, or one year, amounts to 112-KW. hours. At a cost of 1 cent per KW.-hour, this amounts to $1·12, which at 10 per cent., allowing for depreciation as well as interest, represents a capital of $11·20; in other words, the buyer could, with advantage, pay any amount up to $11 more for the sake of getting better material in his core, and the manufacturer could pay 28 cents per pound more for the 40 lb. of material used. If the better silicon steel were to cost 2·8 cents more than the other (which is improbable), the difference in cost of the steel would be $1·12, and the user would each year save 100 per cent. of extra cost.

The comparison between the power silicon steel and the ordinary steel is even more marked. In a case cited the difference in core loss would be the equivalent of $1·45 per year, thus practically reducing the value of the transformer by $24·50; yet the difference in cost of the material is only $2·70 if the price of silicon steel delivered at the factory is taken at 7½ cents per pound, and that of ordinary steel at 3¼ cents per pound, assuming 40 lb. to be necessary.

INCOME-TAX ASSESSMENT.

Allowances for Depreciation.

The following is an abstract from the official arrangement made between the Tramways and Light Railways Association and the Board of Inland Revenue with respect to allowances for depreciation in electric tramway and lighting undertakings for the purpose of income-tax assessment. This scheme applies to municipalities as well as to companies:—

Tramways.

Permanent-Way.—Allowance for Maintenance to Cover Depreciation.

Life.

1. The life of the permanent-way is to be taken as 12, 14, or 16 years, according to the traffic thereon. The classification is to be based on the average car-mileage per mile of track per annum of the financial year preceding the year of assessment, viz.:—

(1) Not exceeding 50,000 car-mile per mile of track—16 years.
(2) Over 50,000 and not exceeding 75,000 car-miles per mile of track—14 years.
(3) Over 75,000 and not exceeding 125,000 car-miles per mile of track—12 years.
(4) Over 125,000 car-miles per mile of track—special consideration.

2. Where there are special circumstances, such as exceptional gradients, and the compulsory use of wood-paving, &c., tending to show that the car-mileage does not fairly represent the wear-and-tear of the track, each such case is entitled to special consideration.

Cost of Renewals.

3. The cost of renewals, including setts or other paving, but excluding concrete foundations, should be taken at £4,400 per mile of single track until the general renewal of the track takes place.

Basis of Computation of Depreciation Allowance.

4. No allowance should be made in computing the assessable profits in respect of any expenditure on repairs or maintenance of the permanent-way, but the allowance for depreciation should be computed at such a sum per annum as will in the aggregate, over the determined life of the permanent-way, be equal to the cost of renewal as above fixed, plus the estimated repairs for that period:—

Cost of renewal per mile as above	£4,400
Add, for example:	
Estimated cost of repairs at £100 per mile per annum, for an undertaking with a life of 16 years	1,600
	£6,000
Amount to be allowed per annum in lieu of depreciation, $\frac{1}{16}$th	375

5. The amount to be added in respect of ordinary repairs should be determined by taking the actual average expenditure as shown in the accounts of the undertaking for *the last three years*, or such period less than three years, as the undertaking has been in existence.

6. Repairs under this head should be understood to include renewals of special track-work at junctions and cross-overs, which occur at frequent intervals.

Periodical Adjustment.

7. Inasmuch as the expenditure on repairs is expected to increase as the track begins to wear, in which case the figure to be adopted under this head, which is to be based on past experience, will be unsatisfactory, the amount of such estimate should come up for revision at the end of every five years, and an adjustment should be made by increasing or diminishing the allowance as the circumstances require, having regard to the basis of calculation outlined above.

8. A strict account should be kept by the corporation and the surveyor of the annual allowances and of the actual expenditure on repairs and renewals; and at the end of 10 or 15 years (*i.e.*, the second or third revision), or at such time as the general renewal of the track shall have taken place, the amount to be annually allowed should be reconsidered and increased or diminished for succeeding years as the ascertained facts shall show to be necessary, provided that under no circumstances shall the allowances for previous years be re-opened.

9. All expenditure on extensions and improvements should be excluded from the working expenses for income-tax purposes; and the necessary additional allowance for depreciation on the lines suggested above (*i.e.*, mileage) should be at once allowed on such expenditure, and added to the sum already allowable.

10. The allowance of £4,400 for renewal of permanent-way mentioned above is intended to apply to the overhead trolley system. Special arrangements should be made, on the lines of the foregoing, in the case of the conduit, surface contact, or other system. The number of such cases is very small. As the circumstances vary very considerably in each case, the amount to be allowed for renewals should in the first instance be arrived at by arrangement with the Chief Inspector of Taxes.

Cables.

11. In addition to repairs, depreciation should be allowed at the rate of 3 per cent. per annum on the written-down value.

Overhead Equipment—i.e., Trolley Wires and Connections.

12. No depreciation should be allowed; all expenditure on maintenance and renewals should be charged as working expenses, as and when incurred.

Cars and other Rolling Stock.

13. Subject to the ensuing clause, expenditure on maintenance and renewals should be treated as working expenses, and allowed in lieu of depreciation.

14. Depreciation, however, should be allowed in lieu of renewals where the circumstances justify such an allowance, provided that a strict account is kept of all renewals, and that if such renewals are charged to revenue account they shall be shown separately in such account and added back in computing the assessable profits.

15. The allowance in such case should be 7 per cent. per annum on the written-down value.

16. In any case, the annual expenditure on repairs is to be allowed as a deduction in computing the assessable profits.

General Plant and Machinery.

17. All other plant and machinery, including standards, brackets, and workshop tools, but excluding loose implements, office furniture, and small articles which require frequent renewal, should be bulked together and depreciation allowed thereon at the rate of 5 per cent. per annum on the written-down value, in addition to the cost of repairs.

Electric Lighting Undertakings.

Cables.

21. In addition to repairs, allowance for depreciation may be granted at the rate of 3 per cent. per annum on the written-down value.

Plant and Machinery.

22. On all other plant, exclusive of loose tools, meters, and office furniture, depreciation may be allowed at the rate of 5 per cent. per annum on the written-down value, in addition to the cost of repairs.

Conduits.

23. No allowance should be made for depreciation, but annual expenditure on repairs and renewals may be allowed as working expenses, as and when incurred.

Meters, Loose Tools and Office Furniture.

24. No allowance should be made for depreciation; but annual expenditure on repairs and renewals may be allowed as working expenses, as and when incurred.

General.

25. In all cases where depreciation allowances are granted, a strict account should be kept of the annual expenditure on renewals (and repairs in the case of tramway tracks), including replacements due to obsolescence, and of the amounts allowed for depreciation and obsolescence, whether under this arrangement, or under any arrangement made prior hereto, and a readjustment should be made for the future, if necessary, at the end of every five years, as detailed under Tramways (Permanent Way), subject, however, to the special provisions applicable to Tramways (Permanent Way).

26. Where depreciation allowances other than those for the permanent way of tramways are granted, renewals should be carefully distinguished, and, if charged against revenue, they should be notified to the surveyor, in order that they may be added back in arriving at the income-tax liability.

27. "Written down value" means original prime cost, plus subsequent additions, less all allowances actually granted by the revenue in respect of wear and tear.

28. These proposals are to take effect for the year 1908-9, and for years preceding in cases where claims of depreciation are at the present time awaiting settlement.

E

29. The computations necessary for any future adjustment should be duly made, agreed and recorded each year, whether the accounts for the particular year under review show any assessable income-tax liability or not.

30. Where, in any cases, allowances for depreciation have been made which are now to be discontinued, and they have not been exhausted by renewals already effected, the amount of such unexhausted allowances should be determined by agreement between the surveyor and the corporation or company, and deducted from the expenditure on future renewals as and when they are effected.

31. All cases of dispute should be referred to the Board through the chief inspector of taxes.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

A New Arc Lamp Winch.

The North-Western Electrical Appliance Co., of Cathcart, Glasgow, who, as our readers are aware, are manufacturers of arc lamp gear and accessories, have recently placed on the market an arc lamp winch of considerable merit.

Our illustration shows all the parts of this winch, in which a coiled spring replaces the frequently numerous parts in the ingenious winches to which our readers may have noticed references in these columns during the past year or two. The winch is self-sustaining, and direct winding and unwinding; it gives a sensitive feel, thus preventing overstraining of ropes; it also allows rapid winding and unwinding, and freedom from sudden jars. Its simplicity is a great point in its favour; no adjustment being required for varying weights between 2 and 100 lb.

Our London readers will be able to examine this new winch as also the several other types which the North-Western Co. have placed on the market, at the headquarters of the Globe Electric Co.,

Fig. 1.—The "Fixator" Arc Lamp Winch.

11, Farringdon Avenue, E.C. The Globe Electric Co. have been appointed sole agents for the North-Western Co., for London and provinces South of the Midlands, as well as for export work.

"Whipall" Electric Tire Pump.

The rapid and continued increase in the number of motor vehicles has created an urgent demand for a reliable power-driven tire pump, as the hand pump is altogether inadequate in establishments where the expeditious turning out of cars is a necessity. The "Whipall" electric tire pump supplied by Mr. E. E. Cox, 77, St. John's Road, Bootle, has been specially designed and put on the market to meet this demand. As will be seen from fig. 2, the apparatus consists of an electromotor geared direct to a reciprocating air compressor, mounted on a substantial cast-iron base, and entirely enclosed in a strong iron case. Amongst the special features of this pump are the oil filter or arrester, which the makers inform us effectually prevents any trace of oil from passing into the tires (a point of vital importance) and which we understand is easily cleaned and adjusted; also to obviate the risk of tires being strained or damaged, an automatic adjustable safety valve is fitted, to act at any predetermined pressure, as shown on a gauge, visible on the outside of the containing case. Both the filter and gauge are readily accessible. The air tube is provided with a patent connector fitting any tire valve, the connection being made by simply pushing the connector over the valve nozzle, without the necessity of screwing, thus saving what is often very valuable time.

The set is supplied with an ample length of steel armoured flexible twin cable, fitted with bayonet or pin plug adapter, and switch.

The outfit is specially designed to stand rough usage and is practically fool-proof, quite portable, and supplied for all voltages. The motor is made to stand heavy overloads such as would be caused by choked tire valves, and is capable of fully inflating the standard motor cab tire in 90 seconds on an energy consumption of about 250 watts.

As a quick, reliable and ready means of tire inflating, the makers claim that their pump is unequalled by any other apparatus at

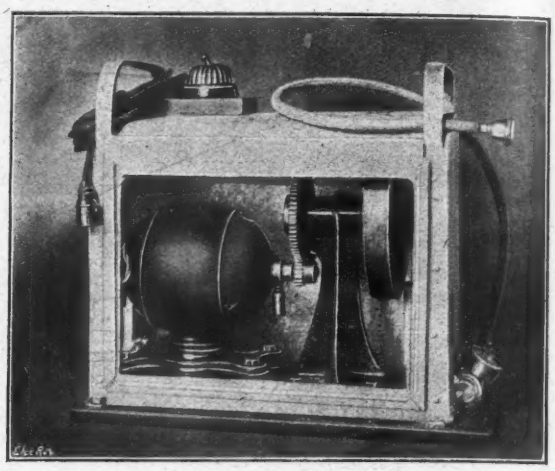


Fig. 2.—The "Whipall" Electric Tire Pump.

present on the market, and the advantages of the electrical drive are obvious.

An Oil-Immersed Motor-Starter.

We illustrate a new type of motor-starter now being put on the market by Messrs. Reyrolle, of Hebburn-on-Tyne. It has been found that there is a considerable demand for small capacity

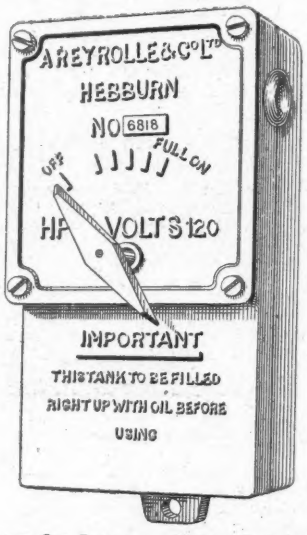


Fig. 3.—Small Oil Immersed Motor Starter.

starters, at a price, at which the firm cannot supply their patent resistance type, and this new design has been produced to meet the case.

These oil-immersed starters are made in two sizes only, namely, up to ½-H.P. and up to 2-H.P., and, as the ½-H.P. starter is only 9½ in. high, it is clear that the design is particularly compact.

The resistance consists of wire immersed in oil, and the starter can be operated 15 or 20 times an hour, without injury. An important feature is, that all the contacts are placed in a strong magnetic field, and owing to the entire absence of sparking, no trouble is experienced due to blackening and burning of the contacts.

The present design provides for no-voltage release only, as Messrs. Reyrolle have found that the demand for double automatic starters in these small sizes is decidedly limited. The design is simple as well as cheap, and capable of rapid production in quantities.

Simplex Porcelain Fuses.

Messrs. Simplex Conduits, Ltd., are energetically pushing the supply of distribution boards, fuses and fuse wires. In the latter direction special efforts are being made to meet the very large demand which exists. Our illustration, fig. 4, shows a large extruding press, weighing considerably over 10 tons, which has recently been installed at their Garrison Lane works for the purpose of the manufacture of fuse wire. The working pressure on the ram is 400 tons, and the press is fed by a vertical pump working at a pressure of 2 tons to the square inch. The press has been specially designed with a view to the peculiar requirements of the case. The fitting of special safety valves and facilities

for rapid recharging with metal alloy, from which the fuse wire is made, contribute to make it one of the most up-to-date extruding presses yet designed. The molten metal is poured into a container, and maintained in liquid form by means of gas rings. The control is simple and effective, and the pump actuating the press is driven by an electric motor. With the latest and most up-to-date

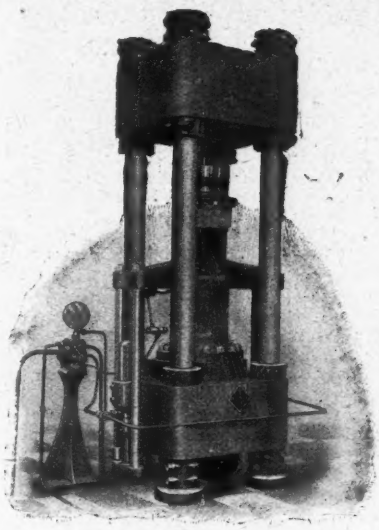


Fig. 4.—Special Press for Producing Simplex Fuse Wire.

improvements, the firm claim to be able to supply fuse wire at strictly competitive prices, and to undertake large contracts for same.

A new form of fuse carrier, just introduced, departs only slightly from the standard design at present so popular. The fuse will fit any type of board of standard dimensions, and permits fuses being

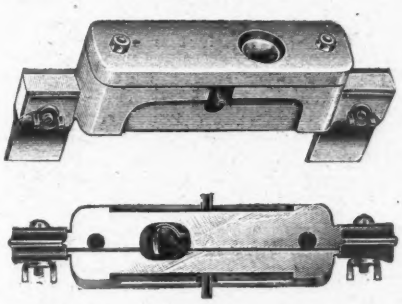
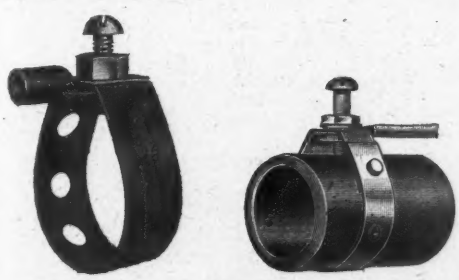


Fig. 5.—Indicating Porcelain Fuse Bridge.

easily and safely renewed by unskilled persons. In our illustration of this fuse carrier the indicator, coloured red, is shown on the front at the hole on the front view when fuse is blown. The fuse wire is carried at the back, well out of the way, and the spring of the indicator is attached to the fuse wire by means of a hook provided. Two wing nuts bind down the fuse wire, and render replacements an easy matter.

An American Ground Clamp.

The improved Blackburn Ground Clamp is being introduced into this country by the Bureau of American Manufacturers, of 17-20, West Smithfield, E.C.; on the other side it is used for connecting ground wires to pipes.



Figs. 6 and 7.—Blackburn Ground Clamps.

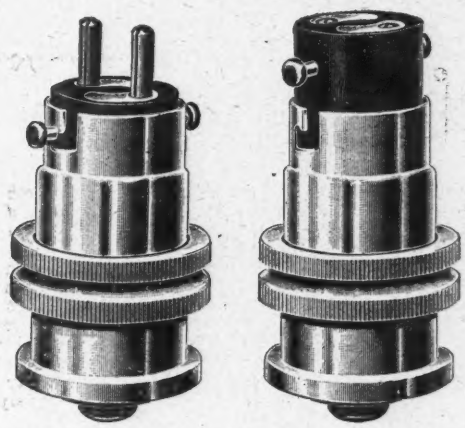
The illustrations show the arrangement, which consists of a flexible metal strap, which can be cut to any required length and looped round the pipe; the screw is then inserted through convenient holes and tightened up against the pipe, the ground wire being subsequently secured by the nut shown. It is claimed that the strap chafes the pipe when being tightened and thereby secures good electrical contact.

Special shoes are provided, if desired, for insertion between screw and pipe, to prevent injury to the latter.

Combined Wall and Lamp Plug.

Messrs. Jones & Meakin Ltd., of 28, Birkbeck Bank Chambers, Holborn, W.C., have recently placed on the market an ingenious combination wall and lamp plug, which we illustrate herewith in its double capacity.

The essential feature of the device is the central sliding ebonite block which carries the contacts and pins for the lamp socket (fig. 9),



Figs. 8 & 9.—The "Perfect" Combined Wall and Lamp Plug.

and which when pushed home (against two springs) and secured in exactly the same way as a lamp, causes two split pins to project for use with wall sockets &c. (fig. 8). The illustrations show clearly the nature of the fitting, which is solidly and carefully constructed, and, moreover, moderate in price.

It is known as the "Perfect" combined wall and lamp plug and is being patented by the makers.

BRITISH ASSOCIATION MEETING AT WINNIPEG.

Address by Prof. Sir J. J. Thomson, M.A., LL.D., D.Sc., F.R.S., President.

(Delivered on Wednesday, August 25th.)

Twenty-five years ago a great change was made in the practice of the British Association. From the foundation of our Society until 1884 its meetings had always been held in the British Isles; in that year, however, the Association met in Montreal, and a step was taken which changed us from an insular into an Imperial Association.

This year, for the third time in a quarter of a century, we are meeting in Canada. As if to give us an object lesson in the growth of Empire, you in Winnipeg took the opportunity at our first meeting in Canada in 1884 to invite our members to visit Manitoba and see for themselves the development of the Province at that time. Those who were fortunate enough to be your guests then as well as now are confronted with a change which must seem to them unexampled and almost incredible. Great cities have sprung up, immense areas have been converted from prairies to prosperous farms, flourishing industries have been started, and the population has quadrupled. As the president of a scientific Association I hope I may be pardoned if I point out that even the enterprise and energy of your people and the richness of your country would have been powerless to effect this change without the resources placed at their disposal by the labours of men of science.

I have had the privilege of having as pupils students from your Universities as well as from those of New Zealand, Australia and the United States, and have thus had opportunities of comparing the effect on the best men of the educational system in force at your Universities with that which prevails in the older English Universities. As the result, I have come to the conclusion that there is a good deal in the latter system which you have been wise not to imitate. The chief evil from which we at Cambridge suffer, and which you have avoided, is, I am convinced, the excessive competition for scholarships which confronts our students at almost every stage of their education. The colleges in the University of Cambridge alone give more than £35,000 a year in scholarships to undergraduates, and I suppose the case is much the same at Oxford. The result of this is that preparation for these scholarships dominates the education of the great majority of the cleverer boys who come to these Universities. The preparation for the scholarship too often means that about two years before the examination the boy begins to specialise, and from the age of 16 does little else

than the subject, be it mathematics, classics or natural science, for which he wishes to get a scholarship; then, on entering the University, he spends three or four years studying the same subject before he takes his degree, when his real life work ought to begin. How has his training fitted him for this work? Though he has acquired knowledge, the effect of studying one subject, and one subject only, for so long a time, is too often to dull his enthusiasm for it, and he begins research with much of his early interest and keenness evaporated. Now there is hardly any quality more essential to success in research than enthusiasm. Research is difficult, laborious, often disheartening.

I am convinced that no greater evil can be done to a young man than to dull his enthusiasm. In a very considerable experience of students of physics beginning research, I have met with more—many more—failures from lack of enthusiasm and determination than from any lack of knowledge or of what is usually known as cleverness.

The premature specialisation fostered by the preparation for these scholarships injures the student by depriving him of adequate literary culture, while when it extends, as it often does, to specialisation in one or two branches of science, it retards the progress of science by tending to isolate one science from another. The boundaries between the sciences are arbitrary, and tend to disappear as science progresses.

Again, the specialisation prevalent in schools often prevents students of science from acquiring sufficient knowledge of mathematics; it is true that most of those who study physics do some mathematics, but I hold that, in general, they do not do enough, and that they are not as efficient physicists as they would be if they had a wider knowledge of that subject. There seems at present a tendency in some quarters to discourage the use of mathematics in physics; indeed, one might infer, from the statements of some writers in quasi-scientific journals, that ignorance of mathematics is almost a virtue. If this is so, then surely of all the virtues this is the easiest and most prevalent.

Two points of view are better than one, and the physicist who is also a mathematician possesses a most powerful instrument for scientific research with which many of the greatest discoveries have been made; for example, electric waves were discovered by mathematics long before they were detected in the laboratory. He has also at his command a language clear, concise, and universal, and there is no better way of detecting ambiguities and discrepancies in his ideas than by trying to express them in this language. Again, it often happens that we are not able to appreciate the full significance of some physical discovery until we have subjected it to mathematical treatment, when we find that the effect we have discovered involves other effects which have not been detected, and we are able by this means to duplicate the discovery.

Pure mathematicians have been indebted to the study of concrete problems for the origination of some of their most valuable conceptions. Most of us need to tackle some definite difficulty before our minds develop whatever powers they possess, and I think the moral to be drawn is that we should aim at making the education in our schools as little bookish and as practical and concrete as possible.

It is possible to read books, to pass examinations, without the higher qualities of the mind being called into play. Indeed, I doubt if there is any process in which the mind is more quiescent than in reading without interest.

I think it was Helmholtz who said that often in the course of a research more thought and energy were spent in reducing a refractory piece of brass to order than in devising the method or planning the scheme of campaign. This constant need for thought and action gives to original research in any branch of experimental science great educational value even for those who will not become professional men of science. I have had considerable experience with students beginning research in experimental physics, and I have always been struck by the quite remarkable improvement in judgment, independence of thought and maturity produced by a year's research. Research develops qualities which are apt to atrophy when the student is preparing for examinations, and, quite apart from the addition of new knowledge to our store, is of the greatest importance as a means of education.

It is the practice in many universities to make special provision for the reception of students from other universities who wish to do original research or to study the more advanced parts of their subject, and considerable numbers of such students migrate from one university to another. I think it would be a good thing if this practice were to extend to students at an earlier stage in their career; especially should I like to see a considerable intercharge of students between the universities in the Mother Country and those in the Colonies.

The period which has elapsed since the Association last met in Canada has been one of almost unparalleled activity in many branches of physics, and many new and unsuspected properties of matter and electricity have been discovered. The history of this period affords a remarkable illustration of the effect which may be produced by a single discovery; for it is, I think, to the discovery of the Röntgen rays that we owe the rapidity of the progress which has recently been made in physics. A striking discovery like that of the Röntgen rays acts much like the discovery of gold in a sparsely populated country; it attracts workers who come in the first place for the gold, but who may find that the country has other products, other charms, perhaps even more valuable than the gold itself. The country in which the gold was discovered in the case of the Röntgen rays was the department of physics dealing with the discharge of electricity through gases, a subject which, almost from the beginning of electrical science, had attracted a few enthusiastic workers, who felt convinced that the key to unlock the secret of electricity was to be found in a vacuum tube. It is not to the power of probing dark places, important though this is, that the influence of Röntgen rays on the progress of science has mainly been due; it is rather because these rays make gases, and, indeed, solids and liquids, through which they pass conductors of electricity.

The study of gases exposed to Röntgen rays has revealed in such gases the presence of particles charged with electricity; some of these particles are charged with positive, others with negative electricity.

The properties of these particles have been investigated; we know the charge they carry, the speed with which they move under an electric force, the rate at which the oppositely charged ones recombine, and these investigations have thrown a new light, not only on electricity, but also on the structure of matter.

We know from these investigations that electricity, like matter, is molecular in structure, that just as a quantity of hydrogen is a collection of an immense number of small particles called molecules, so a charge of electricity is made up of a great number of small charges, each of a perfectly definite and known amount.

The great advantage of the electrical methods for the study of the properties of matter is due to fact that whenever a particle is electrified it is very easily identified, whereas an uncharged molecule is most elusive; and it is only when these are present in immense numbers that we are able to detect them.

We can by the electrical method detect the presence of three or four charged particles in a cubic centimetre. Rutherford has shown that we can detect the presence of a single α particle. Now the particle is a charged atom of helium; if this atom had been uncharged we should have required more than a million million of them, instead of one, before we should have been able to detect them.

We have already made considerable progress in the task of discovering what the structure of electricity is. We know that negative electricity is made up of units, all of which are of the same kind; that these units are exceedingly small compared with even the smallest atom, for the mass of the unit is only $\frac{1}{1700}$ part of the mass of an atom of hydrogen; that its radius is only 10^{-13} centimetre, and that these units, "corpuscles" as they have been called, can be obtained from all substances. The size of these corpuscles is on an altogether different scale from that of atoms; the volume of a corpuscle bears to that of the atom about the same relation as that of a speck of dust to the volume of this room. Under suitable conditions they move at enormous speeds which approach in some instances the velocity of light. The whole of the mass of the corpuscle arises from its charge.

We know a great deal about negative electricity; what do we know about positive electricity? In the first place, we find that the positive particles—"canalstrahlen"—discovered by Dr. Goldstein, which are found when an electric discharge passes through a highly rarefied gas, are, when the pressure is very low, the same, whatever may have been the gas in the vessel to begin with.

Some experiments made lately by Wellisch, in the Cavendish Laboratory, strongly support the view that there is a definite unit of positive electricity independent of the gas from which it is derived. These and similar results lead to the conclusion that the atoms of the different chemical elements contain definite units of positive as well as of negative electricity, and that the positive electricity, like the negative, is molecular in structure.

The investigations made on the unit of positive electricity show that it is of quite a different kind from the unit of negative. The mass of the negative unit is exceedingly small compared with any atom; the only positive units that up to the present have been detected are quite comparable in mass with the mass of an atom of hydrogen; in fact, they seem to equal it. This makes it more difficult to be certain that the unit of positive electricity has been isolated, for we have to be on our guard against its being a much smaller body attached to the hydrogen atoms which happen to be present in the vessel. If the positive units have a much greater mass than the negative ones, they ought not to be so easily deflected by magnetic forces when moving at equal speeds; and in general the insensibility of the positive particles to the influence of a magnet is very marked; though there are cases when the positive particles are much more readily deflected, and these have been interpreted as proving the existence of positive units comparable in mass with the negative ones. I have found, however, that in these cases the positive particles are moving very slowly, and that the ease which they are deflected is due to the smallness of the velocity and not to that of the mass. At present the smallest positive electrified particles of which we have direct experimental evidence have masses comparable with that of an atom of hydrogen.

A knowledge of the mass and size of the two units of electricity, the positive and the negative, would give us the material for constructing what may be called a molecular theory of electricity, and would be a starting-point for a theory of the structure of matter; for the most natural view to take, as a provisional hypothesis, is that matter is just a collection of positive and negative units of electricity, and that the forces which hold atoms and molecules together, the properties which differentiate one kind of matter from another, all have their origin in the electrical forces exerted by positive and negative units of electricity, grouped together in different ways in the atoms of the different elements.

As it would seem that the units of positive and negative electricity are of very different sizes, we must regard matter as a mixture containing systems of very different types, one type corresponding to the small corpuscle, the other to the large positive unit.

Since the energy associated with a given charge is greater the smaller the body on which the charge is concentrated, the energy

stored up in the negative corpuscles will be far greater than that stored up by the positive. The amount of energy which is stored up in ordinary matter in the form of the electrostatic potential energy of its corpuscles is, I think, not generally realised. All substances give out corpuscles, so that we may assume that each atom of a substance contains at least one corpuscle. From the size and the charge on the corpuscle, both of which are known, we find that each corpuscle has 8×10^{-7} ergs of energy; this is on the supposition that the usual expressions for the energy of a charged body hold when, as in the case of a corpuscle, the charge is reduced to one unit. Now, in one gramme of hydrogen there are about 6×10^{23} atoms, so if there is only one corpuscle in each atom, the energy due to the corpuscles in a gramme of hydrogen would be 48×10^{16} ergs, or 11×10^{9} calories. This is more than seven times the heat developed by one gramme of radium, or by the burning of 5 tons of coal. Thus we see that even ordinary matter contains enormous stores of energy; this energy is, fortunately, kept fast bound by the corpuscles; if, at any time, an appreciable fraction were to get free, the earth would explode and become a gaseous nebula.

The matter of which I have been speaking so far is the material which builds up the earth, the sun, and the stars, the matter studied by the chemist, and which he can represent by a formula; this matter occupies, however, but an insignificant fraction of the universe, it forms but minute islands in the great ocean of the ether, the substance with which the whole universe is filled.

The ether is not a fantastic creation of the speculative philosopher; it is as essential to us as the air we breathe. For we must remember that we on this earth are not living on our own resources: we are dependent from minute to minute upon what we are getting from the sun, and the gifts of the sun are conveyed to us by the ether. To the sun we owe not merely night and day, springtime and harvest; it is the energy of the sun, stored up in coal, in waterfalls, in food, that practically does all the work of the world.

How great is the supply the sun lavishes upon us becomes clear when we consider that the heat received by the earth under a high sun and a clear sky is equivalent, according to the measurements of Langley, to about 7,000 H.P. per acre. Though our engineers have not yet discovered how to utilise this enormous supply of power, they will, I have not the slightest doubt, ultimately succeed in doing so; and when coal is exhausted and our water-power inadequate, it may be that this is the source from which we shall derive the energy necessary for the world's work. When that comes about, our centres of industrial activity may perhaps be transferred to the burning deserts of the Sahara, and the value of land may be determined by its suitability for the reception of traps to catch sunbeams.

This energy, in the interval between its departure from the sun and its arrival at the earth, must be in the space between them. Thus this space must contain something which, like ordinary matter, can store up energy, which can carry at an enormous pace the energy associated with light and heat, and which can, in addition, exert the enormous stresses necessary to keep the earth circling round the sun and the moon round the earth.

The study of this all-pervading substance is, perhaps, the most fascinating and important duty of the physicist.

On the electromagnetic theory of light, now universally accepted, the energy streaming to the earth travels through the ether in electric waves; thus practically the whole of the energy at our disposal has, at one time or another, been electrical energy. The ether must, then, be the seat of electrical and magnetic forces. We know, thanks to the genius of Clerk Maxwell, the founder and inspirer of modern electrical theory, the equations which express the relation between these forces; although, for some purposes, these are all we require, yet they do not tell us very much about the nature of the ether.

Is the ether dense or rare? Has it a structure? Is it at rest or in motion? are some of the questions which force themselves upon us.

Let us consider some of the facts known about the ether. When light falls on a body and is absorbed by it, the body is pushed forward in the direction in which the light is travelling, and if the body is free to move it is set in motion by the light. Now it is a fundamental principle of dynamics that when a body is set moving in a certain direction, or, to use the language of dynamics, acquires momentum in that direction, some other mass must lose the same amount of momentum; in other words, the amount of momentum in the universe is constant. Thus when the body is pushed forward by the light some other system must have lost the momentum the body acquires, and the only other system available is the wave of light falling on the body; hence we conclude that there must have been momentum in the wave in the direction in which it is travelling. Momentum, however, implies mass in motion. We conclude, then, that in the ether through which the wave is moving there is mass moving with the velocity of light. The experiments made on the pressure due to light enable us to calculate this mass, and we find that in a cubic kilometre of ether carrying light as intense as sunlight is at the surface of the earth, the mass moving is only about one-fifty-millionth of a milligramme. We must be careful not to confuse this with the mass of a cubic kilometre of ether; it is only the mass moved when the light passes through it; the vast majority of the ether is left undisturbed by the light. Now, on the electromagnetic theory of light, a wave of light may be regarded as made up of groups of lines of electric force moving with the velocity of light; and if we take this point of view we can prove that the mass of ether per cubic centimetre carried along is proportional to the energy possessed by these lines of electric force per cubic centimetre, divided by the square of the velocity of light. But though lines of electric force carry some of the ether along with them as they move, the amount so carried, even in the strongest electric fields we can produce, is but a minute fraction of the ether in their neighbourhood.

This is proved by an experiment made by Sir Oliver Lodge in which light was made to travel through an electric field in rapid motion. If the electric field had carried the whole of the ether with it, the velocity of the light would have been increased by the velocity of the electric field. As a matter of fact no increase whatever could be detected, though it would have been registered if it had amounted to one thousandth part of that of the field.

The ether carried along by a wave of light must be an exceedingly small part of the volume through which the wave is spread. Part of this volume are in motion, but by far the greater part is at rest; thus in the wave front there cannot be uniformity, at some parts the ether is moving, at others it is at rest—in other words, the wave front must be more analogous to bright specks on a dark ground than to a uniformly illuminated surface.

The place where the density of the ether carried along by an electric field rises to its highest value is close to a corpuscle, for round the corpuscles are by far the strongest electric fields of which we have any knowledge. We know the mass of the corpuscle, we know from Kaufmann's experiments that this arises entirely from the electric charge, and is therefore due to the ether carried along with the corpuscle by the lines of force attached to it.

A simple calculation shows that one-half of this mass is contained in a volume seven times that of a corpuscle. Since we know the volume of the corpuscle as well as the mass, we can calculate the density of the ether attached to the corpuscle; doing so, we find it amounts to the prodigious value of about 5×10^{10}, or about 2,000 million times that of lead. Sir Oliver Lodge, by somewhat different considerations, has arrived at a value of the same order of magnitude.

Thus around the corpuscle ether must have an extravagant density; whether the density is as great as this in other places depends upon whether the ether is compressible or not. If it is compressible, then it may be condensed round the corpuscles, and there have an abnormally great density; if it is not compressible, then the density in free space cannot be less than the number I have just mentioned.

With respect to this point we must remember that the forces acting on the ether close to the corpuscle are prodigious. If the ether were, for example, an ideal gas whose density increased in proportion to the pressure, however great the pressure might be, then if, when exposed to the pressures which exist in some directions close to the corpuscle, it had the density stated above, its density under atmospheric pressure would only be about 8×10^{-16}, or a cubic kilometre would have a mass less than a gramme; so that instead of being almost incomparably denser than lead, it would be almost incomparably rarer than the lightest gas.

I do not know at present of any effect which would enable us to determine whether ether is compressible or not. And although at first sight the idea that we are immersed in a medium almost infinitely denser than lead might seem inconceivable, it is not so if we remember that in all probability matter is composed mainly of holes. We may, in fact, regard matter as possessing a bird-cage kind of structure in which the volume of the ether disturbed by the wires when the structure is moved is infinitesimal in comparison with the volume enclosed by them. If we do this, no difficulty arises from the great density of the ether; all we have to do is to increase the distance between the wires in proportion as we increase the density of the ether.

Let us now consider how much ether is carried along by ordinary matter, and what effects this might be expected to produce.

The simplest electrical system we know, an electrified sphere, has attached to it a mass of ether proportional to its potential energy, and such that if the mass were to move with the velocity of light its kinetic energy would equal the electrostatic potential energy of the particle. This result can be extended to any electrified system, and it can be shown that such a system binds a mass of the ether proportional to its potential energy. Thus a part of the mass of any system is proportional to the potential energy of the system.

The question now arises, Does this part of the mass add anything to the weight of the body? If the ether were not subject to gravitational attraction it certainly would not; and even if the ether were ponderable, we might expect that as the mass is swimming in a sea of ether it would not increase the weight of the body to which it is attached. But if it does not, then a body with a large amount of potential energy may have an appreciable amount of its mass in a form which does not increase its weight, and thus the weight of a given mass of it may be less than that of an equal mass of some substance with a smaller amount of potential energy. Thus the weights of equal masses of these substances would be different. Now, experiments with pendulums, as Newton pointed out, enable us to determine with great accuracy the weights of equal masses of different substances. Newton himself made experiments of this kind, and found that the weights of equal masses were the same for all the materials he tried. Bessel, in 1830, made some experiments on this subject which are still the most accurate we possess, and he showed that the weights of equal masses of lead, silver, iron, brass did not differ by as much as one part in 60,000.

The substances tried by Newton and Bessel did not, however, include any of those substances which possess the marvellous power of radio-activity; the discovery of these came much later, and is one of the most striking achievements of modern physics.

These radio-active substances are constantly giving out large quantities of heat, presumably at the expense of their potential energy; thus when these substances reach their final non-radio-active state their potential energy must be less than when they were radio-active. Prof. Rutherford's measurements show that

the energy emitted by one gramme of radium in the course of its degradation to non-radio-active forms is equal to the kinetic energy of a mass of $\frac{1}{10}$th of a milligramme moving with the velocity of light.

This energy, according to the rule I have stated, corresponds to a mass of $\frac{1}{10}$th of a milligramme of the ether, and thus a gramme of radium in its radio-active state must have at least $\frac{1}{10}$th of a milligramme more of ether attached to it than when it has been degraded into the non-radio-active forms. Thus if this ether does not increase the weight of the radium, the ratio of mass to weight for radium would be greater by about one part in 13,000 than for its non-radio-active products.

I attempted several years ago to find the ratio of mass to weight for radium by swinging a little pendulum, the bob of which was made of radium. I had only a small quantity of radium, and was not, therefore, able to attain any great accuracy. I found that the difference, if any, in the ratio of the mass to weight between radium and other substances was not more than one part in 2,000. Lately we have been using at the Cavendish Laboratory a pendulum whose bob was filled with uranium oxide. We have got good reasons for supposing that uranium is a parent of radium, so that the great potential energy and large ethereal mass possessed by the radium will be also in the uranium; the experiments are not yet completed. It is, perhaps, expecting almost too much to hope that the radio-active substances may add to the great services they have already done to science by furnishing the first case in which there is some differentiation in the action of gravity.

As our knowledge of the properties of light has progressed we have been driven to recognise that the ether, when transmitting light, possesses properties which, before the introduction of the electromagnetic theory, would have been thought to be peculiar to an emission theory of light and to be fatal to the theory that light consists of undulations.

Take, for example, the pressure exerted by light. This would follow as matter of course if we supposed light to be small particles moving with great velocities, for these, if they struck against a body, would manifestly tend to push it forward, while on the undulatory theory there seemed no reason why any effect of this kind should take place.

Indeed, in 1792, this very point was regarded as a test between the theories, and Bennet made experiments to see whether or not he could find any traces of this pressure. We now know that the pressure is there, and if Bennet's instrument had been more sensitive he must have observed it. It is perhaps fortunate that Bennet had not at his command more delicate apparatus. Had he discovered the pressure of light, it would have shaken confidence in the undulatory theory and checked that magnificent work at the beginning of the last century which so greatly increased our knowledge of optics.

I now pass to a very brief consideration of one of the most important and interesting advances ever made in physics, and in which Canada, as the place of the labours of Profs. Rutherford and Soddy, has taken a conspicuous part. I mean the discovery and investigation of radio-activity. Radio-activity was brought to light by the Röntgen rays. One of the many remarkable properties of these rays is to excite phosphorescence in certain substances, including the salts of uranium, when they fall upon them. Since Röntgen rays produce phosphorescence, it occurred to Becquerel to try whether phosphorescence would produce Röntgen rays. He took some uranium salts which had been made to phosphoresce by exposure, not to Röntgen rays but to sunlight, tested them, and found that they gave out rays possessing properties similar to Röntgen rays. Further investigation showed, however, that to get these rays it was not necessary to make the uranium phosphoresce, that the salts were just as active if they had been kept in the dark. It thus appeared that the property was due to the metal and not to the phosphorescence, and that uranium and its compounds possessed the power of giving out rays which, like Röntgen rays, affect a photographic plate, make certain minerals phosphoresce, and make gases through which they pass conductors of electricity.

Shortly after Becquerel's discovery of uranium, Schmidt found that thorium possessed similar properties. Then Monsieur and Madame Curie, after a most difficult and laborious investigation, discovered two new substances, radium and polonium, possessing this property to an enormously greater extent than either thorium or uranium, and this was followed by the discovery of actinium by Debierne. Now the researches of Rutherford and others have led to the discovery of so many new radio-active substances that any attempts at christening seems to have been abandoned, and they are denoted, like policemen, by the letters of the alphabet.

Mr. Campbell has recently found that potassium, though far inferior in this respect to any of the substances I have named, emits an appreciable amount of radiation, the amount depending only on the quantity of potassium, and being the same whatever the source from which the potassium is obtained or whatever the elements with which it may be in combination.

The radiation emitted by these substances is of three types known as α β and γ rays. The α rays have been shown by Rutherford to be positively electrified atoms of helium, moving with speeds which reach up to about one-tenth of the velocity of light. The β rays are negatively electrified corpuscles, moving in some cases with very nearly the velocity of light itself, while the γ rays are unelectrified, and are analogous to the Röntgen rays.

The radio-activity of uranium was shown by Crookes to arise from something mixed with the uranium, and which differed sufficiently in properties from the uranium itself to enable it to be separated by chemical analysis. He took some uranium, and by chemical treatment separated it into two portions, one of which was radio-active and the other not.

Next Becquerel found that if these two portions were kept for several months, the part which was not radio-active to begin with regained radio-activity, while the part which was radio-active to begin with had lost its radio-activity. These effects and many others receive a complete explanation by the theory of radio-active change which we owe to Rutherford and Soddy.

According to this theory, the radio-active elements are not permanent, but are gradually breaking up into elements of lower atomic weight; uranium, for example, is slowly breaking up, one of the products being radium, while radium breaks up into a radio-active gas called radium emanation, the emanation into another radio-active substance, and so on, and that the radiations are a kind of swan's song emitted by the atoms when they pass from one form to another; that, for example, it is when a radium atom breaks up and an atom of the emanation appears that the rays which constitute the radio-activity are produced.

Thus, on this view the atoms of the radio active elements are not immortal, they perish after a life whose average value ranges from thousands of millions of years in the case of uranium to a second or so in the case of the gaseous emanation from actinium.

When the atoms pass from one state to another they give out large stores of energy, thus their descendants do not inherit the whole of their wealth of stored-up energy, the estate becomes less and less wealthy with each generation; we find, in fact, that the politician, when he imposes death duties, is but imitating a process which has been going on for ages in the case of these radio-active substances.

Many points of interest arise when we consider the rate at which the atoms of radio-active substance disappear. Rutherford has shown that whatever be the age of these atoms, the percentage of atoms which disappear in one second is always the same; another way of putting it is that the expectation of life of an atom is independent of its age—that an atom of radium 1,000 years old is just as likely to live for another thousand years as one just sprung into existence.

Now this would be the case if the death of the atom were due to something from outside which struck old and young indiscriminately; in a battle, for example, the chance of being shot is the same for old and young; so that we are inclined at first to look to something coming from outside as the cause why an atom of radium, for example, suddenly changes into an atom of the emanation. But here we are met with the difficulty that no changes in the external conditions that we have as yet been able to produce have had any effect on the life of the atom; as far as we know at present the life of a radium atom is the same at the temperature of a furnace as at that of liquid air—it is not altered by surrounding the radium by thick screens of lead or other dense materials to ward off radiation from outside, and what to my mind is especially significant, it is the same when the radium is in the most concentrated form, when its atoms are exposed to the vigorous bombardment from the rays given off by the neighbouring atoms, as when it is in the most dilute solution, when the rays are absorbed by the water which separates one atom from another. This last result seems to me to make it somewhat improbable that we shall be able to split up the atoms of the non-radio active elements by exposing them to the radiation from radium; if this radiation is unable to affect the unstable radio-active atoms, it is somewhat unlikely that it will be able to affect the much more stable non-radio-active elements.

The evidence we have at present is against a disturbance coming from outside breaking up the radio-active atoms, and we must therefore look to some process of decay in the atom itself; but if this is the case, how are we to reconcile it with the fact that the expectation of life of an atom does not diminish as the atom gets older? We can do this if we suppose that the atoms when they are first produced have not all the same strength of constitution, that some are more robust than others, perhaps because they contain more intrinsic energy to begin with, and will therefore have a longer life. Now, if when the atoms are first produced there are some which will live for one year, some for ten, some for a thousand, and so on; and if lives of all durations, from nothing to infinity, are present in such proportion that the number of atoms which will live longer than a certain number of years decreases in a constant proportion for each additional year of life, we can easily prove that the expectation of life of an atom will be the same whatever its age may be. On this view the different atoms of a radio-active substance are not, in all respects, identical.

The energy developed by radio-active substances is exceedingly large, one gramme of radium developing nearly as much energy as would be produced by burning a ton of coal. This energy is mainly in the α particles, the positively charged helium atoms which are emitted when the change in the atom takes place; if this energy were produced by electrical forces it would indicate that the helium atom had moved through a potential difference of about two million volts on its way out of the atom of radium. The source of this energy is a problem of the deepest interest; if it arises from the repulsion of similarly electrified systems exerting forces varying inversely as the square of the distance, then to get the requisite amount of energy the systems, if their charges were comparable with the charge on the α particle, could not when they started be further apart than the radius of a corpuscle, 10^{-13} cm. If we suppose that the particles do not acquire this energy at the explosion, but that before they are shot out of the radium atom they move in circles inside this atom with the speed with which they emerge, the forces required to prevent particles moving with this velocity from flying off at a tangent are so great that finite charges of electricity could only produce them at distances comparable with the radius of a corpuscle.

One method by which the requisite amount of energy could be obtained is suggested by the view to which I have already alluded—that in the atom we have electrified systems of very differen

types, one small the other large; the radius of one type is comparable with 10^{-13} cm., that of the other is about 100,000 times greater. The electrostatic potential energy in the smaller bodies is enormously greater than that in the larger ones; if one of these small bodies were to explode and expand to the size of the larger ones, we should have a liberation of energy large enough to endow an α particle with the energy it possesses. Is it possible that the positive units of electricity were, to begin with, quite as small as the negative, but while in the course of ages most of these have passed from the smaller stage to the larger, there are some small ones still lingering in radio-active substances, and it is the explosion of these which liberates the energy set free during radio-active transformation?

The physiological and medical properties of the rays emitted by radium form a field of research in which enough has already been done to justify the hope that it may lead to considerable alleviation of human suffering. It seems quite definitely established that, for some diseases, notably rodent ulcer, treatment with these rays has produced remarkable cures; it is imperative, lest we should be passing over a means of saving life and health, that the subject should be investigated in a much more systematic and extensive manner than there has yet been either time or material for. Radium is, however, so costly that few hospitals could afford to undertake pioneering work of this kind. Fortunately, however, through the generosity of Sir Ernest Cassel and Lord Iveagh, a Radium Institute, under the patronage of His Majesty the King, has been founded in London for the study of the medical properties of radium and for the treatment of patients suffering from diseases for which radium is beneficial.

The new discoveries made in physics in the last few years, and the ideas and potentialities suggested by them, have had an effect upon the workers in that subject akin to that produced in literature by the Renaissance. Enthusiasm has been quickened, and there is a hopeful, youthful, perhaps exuberant, spirit abroad which leads men to make with confidence experiments which would have been thought fantastic 20 years ago. It has quite dispelled the pessimistic feeling, not uncommon at that time, that all the interesting things had been discovered, and all that was left was to alter a decimal or two in some physical constant. There never was any justification for this feeling, there never were any signs of an approach to finality in science. The sum of knowledge is at present, at any rate, a diverging not a converging series. As we conquer peak after peak we see in front of us regions full of interest and beauty, but we do not see our goal, we do not see the horizon; in the distance tower still higher peaks, which will yield to those who ascend them still wider prospects, and deepen the feeling, whose truth is emphasised by every advance in science, that "Great are the Works of the Lord."

On Clark and Weston Standard Cells.

By H. L. Bronson, Ph.D., Assistant Professor of Physics, and A. N. Shaw, B.A., Demonstrator of Physics, McGill University, Montreal.

(Abstract—Section A.—Winnipeg.)

This paper deals mainly with the accuracy and reproducibility of Clark and Weston cells, and it is hoped that it may throw further light on the value of the cell as one of the two legal electrical standards.

The work has been very much facilitated by the courtesy of the Bureau of Standards at Washington, where one of the authors, at the suggestion of Dr. H. T. Barnes, spent some time in the summer vacation of 1908 in studying the construction of modern standard cells. At the invitation of Dr. F. A. Wolff, we have been glad to actively co-operate with the Bureau in the work it has been doing along these lines.

I. *The Reproducibility of the Cells when prepared according to the Specifications of Wolff and Waters.*

The mean of 15 Clark cells made in this way differed, a few weeks after their construction, from the mean of the reference cells of the Bureau of Standards by less than 14 microvolts. The average deviation of our cells from their own mean was not more than 13, while the maximum deviation was only 31 microvolts.

In the case of the Weston cells the figures were similar, but showed somewhat better agreement in every case; the difference between the mean of 13 cells and the mean of the reference cells at the Bureau of Standards being in this case 4 microvolts, the average deviation of the cells from their own mean being 8, and the maximum deviation being 22.

Some of the Clark and Weston cells were made in Washington by one of the writers, and subsequently transported to Montreal. A means of direct comparison with the values of the cells at the Bureau of Standards was thus obtained. This comparison has recently been checked by a second interchange of cells.

We have also had in our possession six Weston cells made at the National Physical Laboratory in London. One of these was damaged in transit; the mean of the other five differed from the mean of our other cells by only 5 microvolts.

II. *The effect of Introducing Slight Simplifications into the Preparation of Materials.*

About 25 cells were constructed in order to examine the effects of slight simplifications in their preparation. It was found that the ingredient of main importance is the mercurous sulphate, which must always be prepared with great care. When unpurified mercurous sulphate was used in a cell, the average electromotive force was found to be from 300 to 500 microvolts higher than that of the normal cell. The purification of the zinc and cadmium salts is not so important, and as the processes are somewhat tedious, especially in the case of cadmium sulphate, it is interesting to see what accuracy may be obtained with various samples of chemically pure commercial sulphates. It was found that no Clark cell made with this modification differed by more than 50 microvolts from the mean of our normal cells, while no Weston cell differed by more than 100 microvolts. Such cells are therefore sufficiently accurate for all practical work.

The presence of basic oxide, oil or small quantities of organic impurities was found to exert only a very small influence on the electromotive force.

III. *The Relative Value of Cells set up according to the Board of Trade Specifications and those set up according to the Specifications of Wolff and Waters.*

Ten Clark cells of the old "test-tube crystal" type were prepared from a number of different samples of chemically pure commercial materials, for the purpose of ascertaining how much they differed in voltage from those set up according to the modern specifications. The average electromotive force of these cells during the first 75 days, neglecting the first day, was 0·31 millivolts higher than the mean of our normal cells. The average deviation of these cells from their own mean was considerable, about 0·06 millivolt, which suggests that there might be a possible variation of three or four in the last figure of the mean for different batches of 10 cells set up with different materials. It is therefore in good agreement with the value (0·00030 volt) given by Wolff and Waters.

IV. *The Ratio of the Electromotive Force of the Weston Cell to that of the Clark.*

The determination of this ratio, which had also been obtained at the Bureau of Standards, was made with the object of furnishing a further check on the reliability of the comparison between our cells and those of the Bureau, and to give added assurance that no errors had been introduced by transportation.

Five Clark cells were connected in series and placed in opposition to seven Westons similarly connected. The difference between the two sets was then measured on a Kelvin-Varley slide by the usual potentiometer method.

The ratio obtained was 0·716,953, which differs from the ratio 0·716,958, determined by Wolff and Waters, by only seven parts in a million. This difference, small as it is, is entirely accounted for by the small differences, as ascertained by direct comparison between our cells and those made at the Bureau of Standards.

BUSINESS NOTES.

Manufacture of Telephones in Australia.—Mail advices from Melbourne received this week, state that the Postal Department is calling for tenders for the supply of 5,000 telephones of Australian manufacture. One of the conditions is that any design or pattern submitted will be considered by the Department, but preference will be given to instruments conforming to the sealed pattern. The latter is similar to the Ericsson type without any distinguishing name. On July 15th, Messrs. O. C. Beale and Co., Messrs. Straeker & Hipsley, of Sydney, and other electrical manufacturers, waited on the Postmaster-General. They contended that the adoption of the Ericsson type as the standard was not wise, as a manufacturer in Australia might lay down a plant for the manufacture of that class of instrument, which later improvements might render obsolete. There were already many improvements, they said, on the Ericsson instrument. If tenderers were allowed to submit the most up-to-date patterns they could manufacture, they said, the industry was more likely to be established on a firm basis in the Commonwealth. Sir John Quick promised to consult the officers of the Department as to whether the form of tender and specifications could be revised in the direction desired by the deputation.

Canadian Tariffs.—The Canadian Customs authorities have recently given a decision to the effect that "commutator bars of copper cut to form for electrical apparatus" are to be classified under No. 453 of the Tariff, the duty being 14 per cent. on British goods, and 27½ per cent. *ad valorem* on those of foreign manufacture.

Book Notices.—"*Journal* of the I.E.E." No. 196, Vol. 43.—This volume contains the following papers:—"Large Gas Engines for Generating Electric Power," by L. Andrews and R. Porter; "Dielectric Strength of Compressed Air," by E. A. Watson; "Kapp-Hopkinson Test on a Single D.C. Machine," by Dr. W. Lulofs; "Fly-wheel Load Equalisers," by J. S. Peck; and "Safety of Working Electrical Plants in Coal Mines," by S. A. Simon. London: E. and F. N. Spon, Ltd. 1909. Price 5s.

"Metallurgy of the Common Metals (Non-Ferrous). By A. H. Sexton and J. S. G. Primrose. Manchester: Scientific Publishing Co. 1909. Price 7s. 6d. net.

"Engineering Units of Measurement." By J. Ramsay. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd. 1909. Price 1s. net.

Theft of Platinum.—For stealing platinum to the value of £173 from the India-Rubber, Gutta-Percha and Telegraph Works Co., Silvertown, George Freakley, chief clerk in the instrument department, was sentenced to six months' hard labour.

Dissolutions and Liquidations. — Ozonisation Syndicate, Ltd.—The creditors and shareholders of the Ozonisation Syndicate, Ltd., of Cecil Chambers, Strand, and Craig's Court House, Craig's Court, Charing Cross, S.W., met on Friday, August 20th, at the Carey Street offices of the Board of Trade, Lincoln's Inn, W.C., Mr. W. J. Warley, Official Receiver, presiding. The accounts filed under the liquidation showed an unsecured debt, £386; assets, £6, and a deficiency of £879, as regards shareholders. According to the observations of the Official Receiver, the company, which is stated to have been promoted by Mr. Maurice Salis-Schwabe, was registered on December 18th, 1907, with a nominal capital of £500 in £1 shares, and was formed to acquire patents for the manufacture, by a cheap process, of aluminium, armour plate, &c., and for the purification of liquid solutions. By the purchase contract which was entered into on December 27th, 1907, the company acquired from Messrs. Murphy, Schwabe, and Leslie Watney, all their rights and interests in certain patents stated to have been applied for and which included the English and foreign (excepting the Canadian and American) rights for an electric purification process for liquid solutions. The consideration for the sale was fixed at £492 in fully-paid shares of the company, of which 246 were to be allotted to Mr. Schwabe, and 123 each to Messrs. Murphy and Watney. The company further agreed to form a company with a capital of not less than £20,000, and to sell the English rights to such new company for £11,992, as to £4,000 in cash and the balance in fully paid shares of the new company. Of this consideration, Mr. Murphy was to receive £3,000 in cash, and £4,992 in fully-paid shares, and Messrs. Schwabe and L. Watney £500 in cash and £1,500 in fully-paid shares, each. It is understood that Mr. Murphy was the inventor of the patents, and that Mr. Schwabe was to receive his portion in consideration of his undertaking to promote the new company and raise the capital required to work the processes. Mr. L. Watney is stated to have been entitled to a portion of the purchase price as consideration for obtaining financial assistance from Mr. R. Watney. The purchase consideration of 492 shares was duly paid. The Ozone Purification Co., Ltd. (the intended new company) was registered on December 20th, 1907, with a nominal capital of £20,000 (its first directors being Messrs. Murphy and Schwabe, Mr. Nicholls afterwards joining the board), and an agreement was entered into between the two companies on December 27th, 1907, for the sale of the English rights in the patents to the Purification Co. in terms of the company's purchase contract of the same date. According to returns of allotments made to the Registrar of Joint Stock Companies 7,992 shares of the Purification Co. were allotted as fully paid to the original vendors. No part of the cash consideration of £4,000 payable by the Purification Co., however, appears to have been received. In consequence, it is stated, of Mr. Schwabe's failure to carry out his undertaking to raise funds, he, by an agreement with Mr. Murphy of February 10th, 1908, to which the two companies were also parties, agreed to retire, and in consideration of being released from all liability in regard to the syndicate transferred his holdings of shares in the two companies to Mr. Murphy. The two companies appear to have been financed by Mr. Reginald Watney, who states that he made advances to the extent of £500, part of which has been repaid to him. The failure of the company is attributed by Mr. Reginald Watney to its inability to make use of the secret processes owing to Mr. Murphy's absence from the country. Upon inquiry at the Patent Office, the Official Receiver was informed that only one patent—viz, that for an improved electrode, for use in purification of water and other liquids, had been granted, and that Mr. Murphy was the registered proprietor of the same, no assignment having been made to the company. In the absence of a quorum, the meeting of creditors was formally adjourned for a week, but the shareholders passed a resolution for the matter to remain in the hands of the Official Receiver, who will therefore act as a liquidator, without a committee of inspection.

Deep Leads Electric Transmission Co., Ltd.—A meeting is to be held at 20, Copthall Avenue, E.C., on September 22nd, to hear an account of the winding up from the liquidator, Mr. E. S. Rawson.

Ely Electrical and General Agency, 24, Hatton Garden, London.—Messrs. D. Santoni and K. Fiedler have dissolved partnership.

Empire Lubricating Co., Ltd.—This company is winding-up voluntarily, with Mr. W. H. Cochran, 51, North John Street, Liverpool, as liquidator.

Stolen Lamps.—On August 20th at the City Police Court, Manchester, G. H. Withers and R. J. Brocklebank, were charged with stealing a box of tantalum lamps, the property of Messrs. Drake & Gorham, Ltd., Manchester. According to the police evidence, the prisoners' own story was that their plan of action was for Withers to conceal himself on the premises until they were closed for the day, when he would get a signal from Brocklebank, indicating that it was safe to leave with the stolen property. The prisoners were remanded until yesterday in order to enable the police to complete their inquiries. The Manchester *Evening News* says that during the last 18 months, some 6,000 tantalum lamps, valued at from £500 to £600, have been stolen from the same firm's premises, the last occasion being between last Saturday and Monday week, when 100 lamps were taken.

Bankruptcy Proceedings.—Herbert Shuttleworth, Cross Court, Briggate, Leeds, electrical engineer.—The gross liabilities are put at £475, of which £465 are expected to rank. The assets are estimated at £84. The causes of failure are ascribed to bad trade and competition. The debtor, who is 27 years of age, was up to February, 1906, a journeyman electrician. At the time mentioned he commenced business as an electrical engineer and contractor on a loan of £20 from his father, who had since advanced money up to a total of £160, all of which was still owing. In addition, his father, in June, 1908, guaranteed a bank overdraft of £200, and the debtor is owing thereon £197. According to the debtor, the business had not paid at any time owing to irregular trade and competition. He states that he took stock roughly in January last, and the statement then made out, but not preserved, showed a small surplus taking stock at cost, but leaving out the amounts owing to his father and the bank. In July he was sued, when he executed a deed of assignment, and at a meeting held on the 16th of that month a statement was submitted showing liabilities £483, assets £100, deficiency £383. An offer of 5s. in the £ was refused, and the principal trade creditors filed a petition. Debtor, who is unmarried, lives with his parents. He has kept a full set of books, but they are not fully posted, and the cash-book is not balanced. The creditors include:—

Electric and General Stores Co., Leeds	£11
London, City and Midland Bank, Leeds	197
J. Shuttleworth, Wakefield	160
Siemens Bros. Dynamo Works, Ltd., Manchester	10
Scattergood & Johnson, Leeds	57

Cessio.—Messrs. Alexander Anderson & Co., electrical engineers, 18, Laird Street, Greenock, are to be examined in the Court House, County Buildings, Greenock, on September 8th, at 11.15 a.m.

Private Meeting.—J. D. Jones & Co., electrical engineers, 5, Midland Crescent, Finchley Road, N.W.—A meeting of the creditors of the above was held on 17th inst., when a statement of affairs was presented showing liabilities £424, and net assets £88. The estate, therefore, showed a deficiency on paper of £336. It was reported that the debtors, J. D. Jones and J. Beddington, started trading in 1906 with a small capital, continuing until last year, when the partnership was dissolved, the dissolution being duly gazetted. The consideration that Beddington had on leaving the concern, was to have been £52, but he only received £8 10s., thus leaving him to rank as a creditor against the estate for £43 10s. The matter was fully discussed at the meeting, the creditors being of the opinion that the debtor should make some offer of composition. The debtor's solicitor, however, thought it was not possible to get any offer, and suggested that the estate should be dealt with under a deed of assignment. The creditors did not approve of this, however, and resolved that if an offer of 4s. in the £ was not forthcoming within 14 days, the debtor should be requested to file his petition in bankruptcy. The following are creditors:—

Edison & Swan, Ltd.	£44	Electrical Fittings Co.	£10
Ellis, Simpson & Saunders	28	Cash creditors:—	
Ernest Roberts	26	"Bankers"	73
Falk, Stadelmann & Co.	23	Beddington, J.	48
Sloan Electrical Co.	15	Sundry creditors:—	
Thomas, F., & Co.	12	Rent	33
Farringdon Eng. Co.	10	Rates	10
Hands, A. C.	10	Fully-secured creditors	25
Galsworthy, Ltd.	10		

Trade Announcements. — The E.M.F. Manufacturing Co announce that they have amalgamated their interests with those of Mr. O. H. Bishop, for many years sales manager of the Edison & Swan Unifed Electric Light Co., Ltd. Mr. Bishop, besides identifying himself financially, will devote his entire time and energies to the company as joint managing director, with Mr. Bein and Mr. Grose. The firm have also acquired the electrical manufactory and electrical business of Mr. T. H. Satchwell, Victoria Works, Walsall, near Birmingham, a manufacturer of special fittings for ship, street, mill and car lighting. The amalgamation will in future be known as the E.M.F., Ltd., under which name it has been registered. All accounts outstanding and owing will be taken over by the new firm, and will be settled in the ordinary way. The company will continue to make a leading feature of high-grade incandescent lamps, metal and carbon, and particular attention will also be devoted to mill, ship, car and street lighting fittings, high and low-tension switchboard work, switchgear and circuit breakers, lighting accessories, cables, and electric heating and cooking apparatus.

The Globe Electric Co., Ltd., 11, Farringdon Avenue, E.C., has been appointed sole agents for the North-Western Electrical Appliance Co., of Cathcart, Glasgow, for London and provinces south of the Midlands, also for export work.

An Australian exchange states that Messrs. Lawrence and Hanson, electrical contractors and manufacturers, have opened a branch office at Wellington, N.Z., in charge of Mr. H. F. Vickery.

The British Gbiffin Chilled Iron and Steel Co, Ltd., ask us to state that the fire which occurred at 139, Cannon Street, E.C., on Sunday last will in no way affect their business. On and after September 1st their London address will be 81, Cannon Street, E.C.

Works Visit.—Thirty members of the Dewsbury and District Association of Engineers, wishful to see for themselves the "Bennis" coking stoker, made a visit of inspection to the firm's works at Little Hulton, Bolton, on Saturday last. They were conducted through the various departments by Mr. A. W. Bennis, M.I.Mech.E., A.I.E.E., and members of the staff. Interest was evoked by the new patent shovel arm gear, an improvement which has been recently introduced to the sprinkling stoker. This new shovel arm is balanced, self-oiling and detachable. The additional arm gives extra strength, and ensures a dead-centre throw.

(*Continued on page* 344.)

ELECTRICAL COLLIERY INSTALLATION IN FIFESHIRE.

In June last Mr. John Paul read an interesting paper before the Mining Institute of Scotland on electrical matters connected with the Lochgelly Iron and Coal Co.'s pits in Fifeshire.

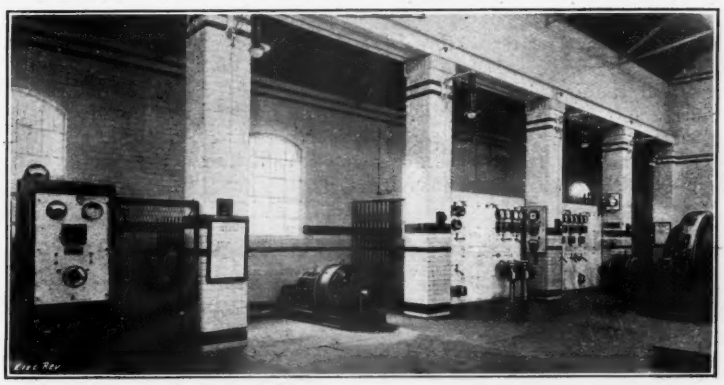
This company has 10 pits distributed over an area of 16 sq. miles, and raising about 1,250,000 tons of coal per annum.

Originally a number of isolated plants sufficed for what was principally lighting work at these pits, but in 1907 the increased possibilities in electric driving led the company to review the whole matter, and after consultation with Messrs. Sayers & Caldwell, of Glasgow, it decided to go in for central generating plant with high-pressure distribution to suitable points.

It was decided to deal with five pits and the workshops in the first instance, and a study of the working conditions showed that between 6 p.m. and 6 a.m. the estimated maximum load would be 613 B.H.P., and during the remainder of the 24 hours, 761 B.H.P.

A site for the power house was decided on at the Nellie pit, and this provided for three 450-KW. sets and a 1,000-KW. exhaust or mixed-pressure turbo-generator. Condensing plant was included in the proposals, not with a view to economising fuel (which costs 2s. 9d. per ton handled), but to obtain good feed water and reduce capital expenditure. As regards the steam supply, superheating and high velocity of steam in the main were adopted, in view of the boilers being some 200 ft. distant from the generating plant.

WATER-TUBE BOILERS FOR THE ELECTRICAL PLANT.



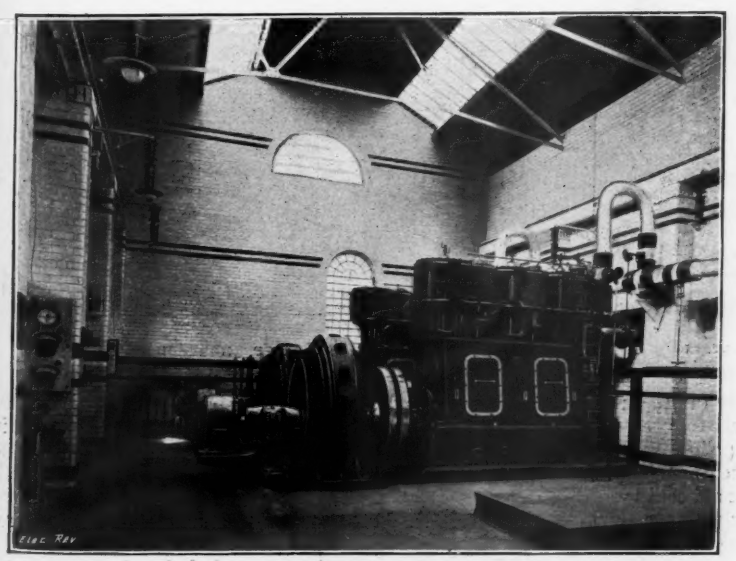
SWITCHGEAR, MOTOR-GENERATOR, AND LOCAL SUB-STATION IN THE POWER STATION.

Four Babcock boilers in pairs have been added to the existing Lancashire boilers at the Nellie pit, and these are constructed for 200 lb. pressure, although worked at 180 lb. Each boiler is fitted with a chain-grate stoker and internal superheater to give 100° F. superheat; the expected maximum evaporation with wet dross and gum is about 10,000 lb. per boiler.

For boiler feed purposes, three single direct-acting steam-driven pumps are installed, made by Andrews & Cameron, of Kirkintilloch.

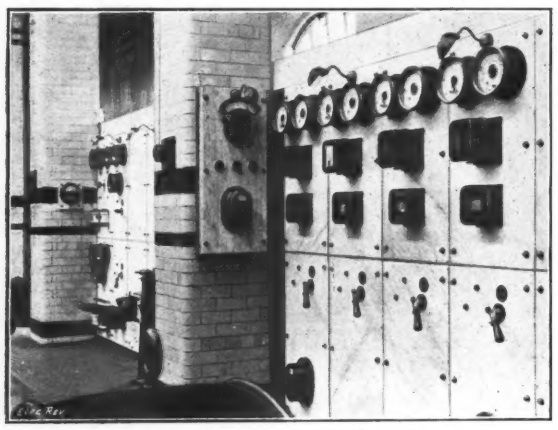
At the present time, two Belliss and Morcom three-crank triple-expansion engines, direct-coupled to Bruce Peebles three-phase alternators, are provided in the power house. The alternators are 50-period machines, generating at 3,300 volts and giving 420 KW. on a ·8 power factor, and at 375 R.P.M.; they are provided with exciters mounted on the main shafts. These sets will carry 25 per cent. overloads for periods of two hours at six hours' intervals, either exhausting into the condenser with a 26-in. vacuum or to atmosphere.

The engines are supplied with steam at 160 to 180 lb. pressure and 470° to 500° F.; both sets on test gave a steam consumption of about 18·3 lb. per KW.-hour with a load of 422 KW., steam pressure 159 lb. and vacuum of 25 in.



BELLISS-BRUCE PEEBLES GENERATING PLANT IN THE POWER STATION.

The engines exhaust through atmospheric valves and Beckett oil separators into an 18-in. cast-iron collecting main, feeding a Ledward & Beckett evaporative condenser outside the engine house; the condenser consists of 336 corrugated pipes in 14 coils of 24 pipes each. A film of water is maintained over these pipes by a 3-H.P. motor-driven centrifugal pump, this requiring the circulation of 10,000 gallons of water per hour, of which 800 gallons is

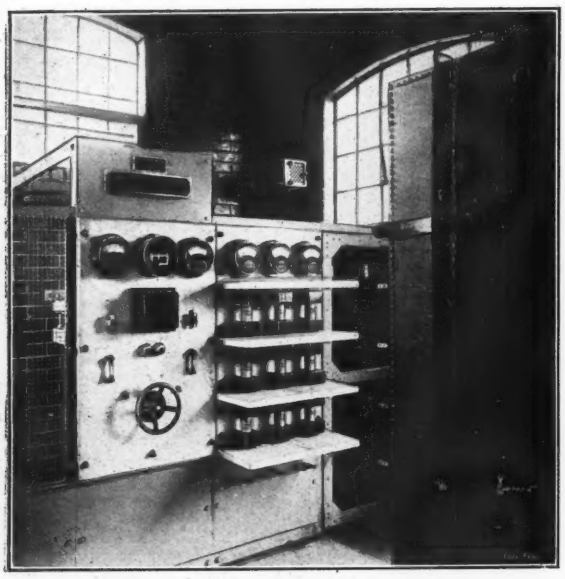


H.T. Panels in Power Station.

evaporated and made up afresh. The adoption of surface condensers would have involved four times as much circulating water, and, in addition, elaborate cooling arrangements.

Accessories to the condenser are a three-throw Edwards air pump, gear driven by a three-phase motor and a force pump for delivering the water passed by the air pump to the Harris-Anderson feed-water purifier, shown in one of our views.

As regards the power house switchgear, the H.T. portion consists of four generator panels and six feeder panels, only two of the former and four of the latter being at present fully



L.T. Panels in Transformer Sub-station.

equipped. The feeder panels in use supply (1) the transformer for the Nellie pit; (2) the transformer for the power house motors; (3) the overhead line supplying the Mary and Newton pits; and (4) the overhead line supplying the workshops, Jenny Grey pits, and the Dundonald colliery.

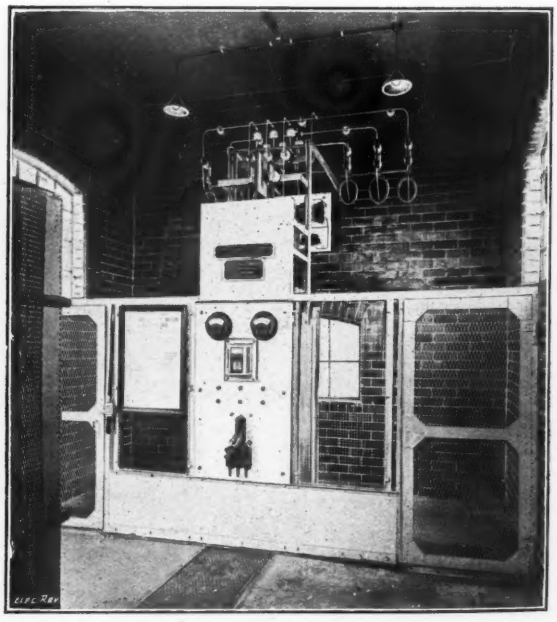
There are, in addition, two panels dealing with L.T. three-phase current from the power house transformer. One of these controls a 50-KW. motor-generator supplying continuous current at 200 volts for the lighting of the power house, Nellie pit-head, and the offices and shops; and the other the air pump, condenser, and centrifugal pump motors. There is also a continuous current panel controlling the 200-volt lighting supply from the motor-generator already mentioned.

All the switch apparatus except the measuring and indicating instruments and the handles of the oil switches are contained in screened cubicles.

Fixed to the sides of the brick piers, within which the main panels are accommodated, are the synchronising bus-bar voltmeter and earth-detecting panels.

Each generator panel contains a three-pole oil switch with automatic reverse power trip gear, indicating wattmeter, ammeter, &c., and the exciter pillar is arranged in front. The feeder panels each carry a similar oil switch with overload and out-of-balance trips, indicating wattmeter, ammeter, and integrating wattmeter.

The L.T. three-phase panels are also fitted with similar oil switches; there are no fuses on any of the three-phase panels. A 10-ton traveller runs the whole length of the power house. The H.T. distributing system consists of overhead lines from the power station to the Mary and Newton pits to the south-west, to the workshops and the Jenny Grey pits to the south-east, and sundry lengths of lead-covered and armoured-paper cables under the North British Railway track and from the power house to the adjacent terminal pole. The general plan (p. 341) gives an idea of the extent of this portion of the work, the heavy dotted line indicating the two lines now in operation, the dotted line from the Jenny Grey pit to the Dundonald colliery, the extension not yet at work, and the chain-dotted lines further extensions, which may or may not be realised. The point, however, of the interconnected network, completed as shown by these chain-dotted lines, is that in conjunction with the special arrangement of isolating switches in the several transformer stations, any section of line, excepting that from the Newton pit to the south, could be made dead (for repairs or other purposes) without interfering with the supply. The earthing guards have been arranged for operation with the supply from either direction, in view of this linking up.



H.T. Panel in Transformer Sub-station.

All cables and apparatus in connection with the overhead lines are protected from the effects of lightning, and excessive pressures from other causes, by spark gaps; and public roads and positions in the vicinity of the pits are guarded by adequate cradling.

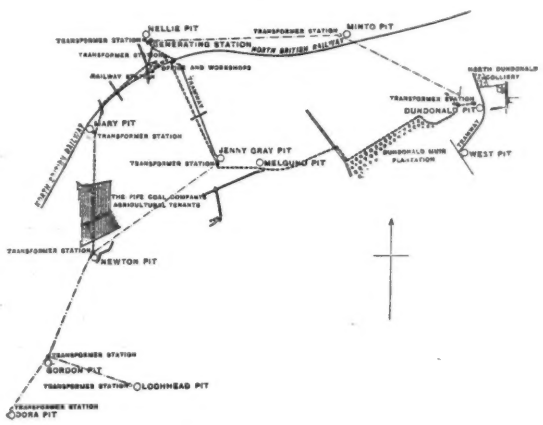
A good idea of the line construction can be obtained from our views.

The transformer stations are each designed to contain two 200-KW. transformers (·8 power-factor), and the necessary

switchgear, but contain only half their equipment at present. The transformers (by the British Electrical Transformer Co.) are oil-cooled and wound to transform from 3,000, 3,150 and 3,300 volts, to 525 volts, these ratios being arranged to compensate for the varying line losses at different points.

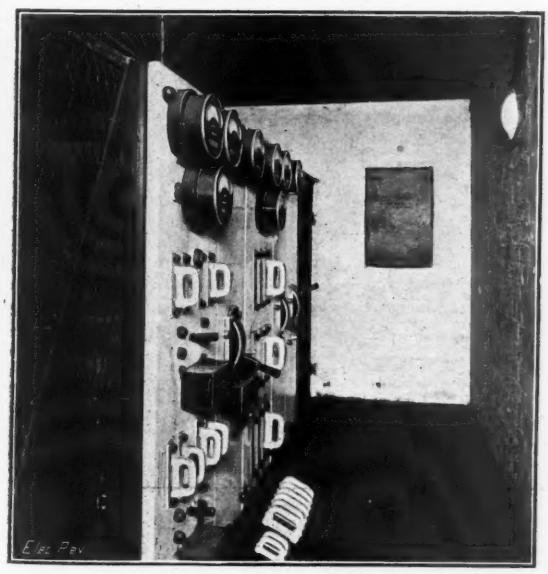
The transformer full-load efficiency is about 97 per cent. The switchgear in the transformer houses is of Ferranti type, comprising a high and low-tension panel for each transformer, with auto-oil switches, instruments, energy meter, &c.; the gear is designed to automatically cut out a faulty transformer, and on the high-tension side space has been left for a high-tension feeder panel in case it is desired to carry high-tension supply down the shafts. On the low-tension side, three 200-KW. circuits are provided.

The shaft and in-bye cables are three-core bitumen insulated and filled, and double armoured with galvanised-steel wires; they are supported in the shafts at intervals of 40 to 50 ft. by cleats of special design, and suspended in-bye by hempen slings. Electrical continuity of the armouring throughout each network is effected by substantial armour-clamping rings, and the whole is efficiently connected to the



PLAN OF AREA SUPPLIED, SHOWING OVERHEAD TRANSMISSIONS, &c.

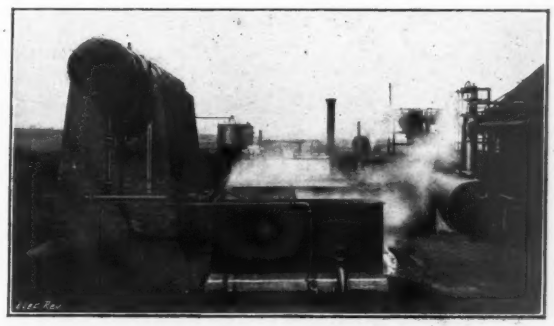
best earth obtainable on the several systems. These cables were supplied by Messrs. Johnson & Phillips, as also were the in-bye switchboards.



VIEW OF IN-BYE SWITCHBOARD.

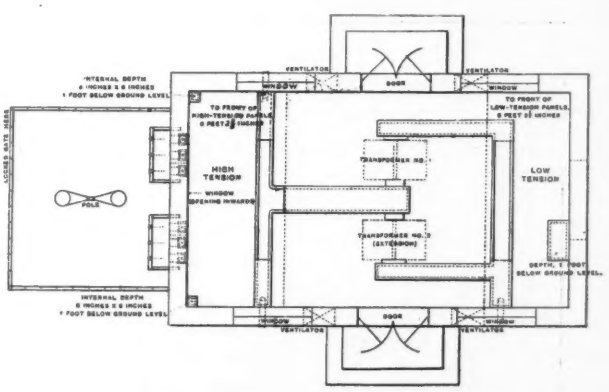
The latter are of very substantial construction, and are designed for underground conditions. Arrangements are also provided on each board by means of auto-transformers for the supply of current to 50 lamps. One of our views shows one of these boards in position.

The sub-circuit fuseboards are of heavy mining type, with



WATER-PURIFYING PLANT AT THE POWER STATION.

porcelain barrel fuses, and have all connections on the front of the slate panels; they are enclosed in cast-iron cases with armour anchor rings, and the lids of braced iron plate are



PLAN SHOWING ARRANGEMENT OF TYPICAL SUB-STATION.

hinged and secured by wing-nuts. They were supplied by Messrs. Harland, Bowden & Co.

Motors have been supplied by the B.T.-H. Co., Mavor and Coulson, and the British Electric Plant Co. for haulage, pump, and fan drives, and include both the slip-ring and squirrel-case types, with control panels and starting switch gear suitable to the particular requirements of each drive.

Coal-cutters have been supplied by two Motherwell firms.

The pits at present outside the area of the three-phase supply are the Minto and the Raith group, the latter comprising the Dora, Gordon and Lochhead pits.

The Minto pit is provided for by two steam dynamos of 100 KW. capacity, and one of 250 KW., generating continuous current at 500 volts.

The Raith group is supplied by two combinations of 100 KW. capacity, which are exact duplicates of the first-named sets at the Minto pit. These are located at the Dora pit, and serve the Gordon and the Lochhead pits in addition by overhead transmission lines.

All these pits have small 200-volt generators for lighting purposes.

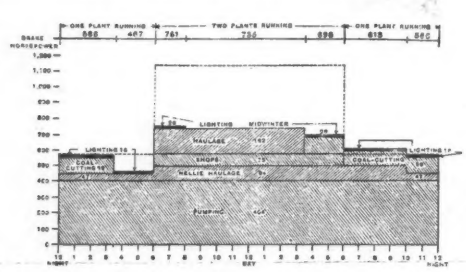
As to the outlay, it may be taken that the generating costs, based on the load diagram (p. 342), plus the capital charges—namely, interest on capital, and sinking fund to redeem the capital in 20 years, will enable the company by the equipment described to deliver electrical energy at any point in the coalfield for something less than 0·3d. per unit; and that with an increased load the cost per unit will be even cheaper, owing to the fact that much of the capital expenditure already incurred really belongs to possible extensions.

In conclusion, we are indebted to Messrs. Sayers and Caldwell for assistance in producing this article.

THE ELECTRIC AUTOMOBILE.

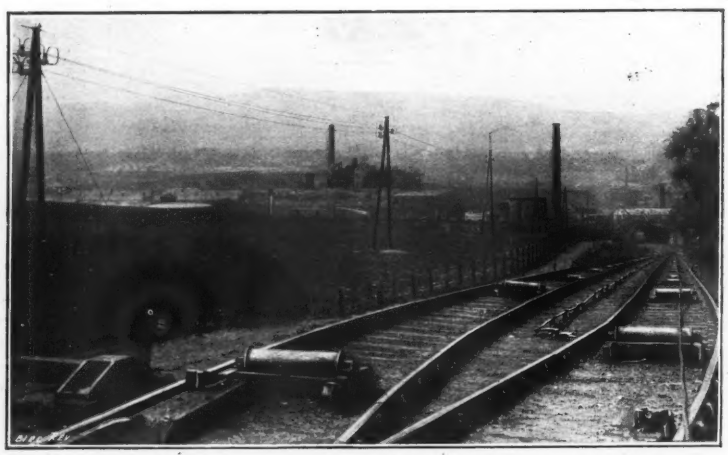
[CONTRIBUTED.]

When the perfect accumulator happen into our existence, of course electric motor-cars will at once supersede petrol



Estimated 24-hour Load, for Present Requirements; Lochgelly Co.'s Installation (p. 339).

vehicles in the majority of cases; that is, they will prove superior in actual working and not merely in the columns of daily newspapers. Meantime, their field is very strictly



An Overhead Transmission, Lochgelly Co.'s Installation.

limited to working in towns or near an economical source of electric supply, and, moreover, within a comparatively small radius in miles of such charging stations.

What advantages do they offer to-day as compared with petrol vehicles?

First of all, apart from the battery, there is much less to go wrong or need frequent repair. Motors and reduction gear have been familiar objects for a long time now in tramway and other power developments, and we know from experience wherein lie their possible weaknesses, which can be, and are, accordingly guarded against by the designer and manufacturer.

A simple controller of the type required for motor-car work is not much more than a compound switch, and costs much less than the speed change-gear box. The differential can be avoided by the use of two small motors instead of one large one.

As for driving and looking after a car, the type of man considered necessary for a petrol vehicle is one who has had one or two years' special training, who is something of a mechanic by instinct as well as experience, and who asks and expects a wage of from 35s. weekly to anything the car owner cares to be persuaded is the man's value.

With electric automobiles—again apart from the battery—the driver can be of a much less skilled type; he has practically to steer the car and turn a handle—work that should be well paid at 25s. a-week, since he may be a younger man of far less experience.

The comparative ease and quietness of running in the case of an electric car will naturally be less pronounced now, in these days of four and six-cylinder petrol cars of high power, than it was before the internal combustion engine made such strides; but, even to-day, it is the electric automobile that attracts attention for the silent way in which it rolls along, not perhaps so speedily as the petrol car, but with really more comfort to the passenger who does not need to be at the other side of nowhere in considerably less than no time.

What are these advantages going to cost a user as compared with the expense of running a petrol car? It is not much good emphasising the excellent features of electric cars if they only come within the reach of the wealthy and the few; they must show themselves adaptable for general employment if the business is to grow, and it is an open question whether this is at present possible.

Some figures have been shown to us in connection with this point that have considerable interest, as they deal with the application of the iron-nickel accumulators of the much-vaunted Edison type; but, taken as a whole, they do not, unfortunately, enable anyone to draw at once a very strong and overwhelming conclusion in favour of electric automobiles. The assumption is made of a heavy car to carry five passengers and the driver, and fitted with a double landaulette or limousine body. Its first cost is given as £775, including the battery and all complete ready for the road.

Allowing £185 for cost of the battery and tires, there remains £590 to represent cost of the chassis with motor, &c., also the body and fittings, and depreciation thereon is allowed at the rate of 15 per cent. per annum—amounting to, say, £88.

Battery depreciation is reckoned at only 50 per cent. per annum on a mileage of, say, 6,250; and 10 per cent. of the first cost is credited for the old cells when returned. This gives an annual depreciation for the battery of about £67, which is equal to about 2·5d. per mile. With such an allowance in a private car that has plenty of rest intervals, how is a rate of only 2d. per mile with lead batteries to be justified in the case of heavy motor-'bus work? Yet this is claimed to be sufficient by the Electrobus Co.

The iron-nickel accumulator being provided with an

Views of Overhead Line, Cradling and Sub-station, Lochgelly Co.'s Installation (p. 339).

alkaline electrolyte, it is necessary to fill up the cells periodically with distilled water in order to prevent the intrusion of acids. The annual cost of this is estimated at about £2 10s.

Power or recharging current will, of course, entail a much varying expense. Assuming an average daily mileage of

22, or about 6,250 per annum, about 125 charges per annum would be required; and for a 64-cell battery about 80 KW.-hours per charge. Two estimates are given of the cost of current—one where the price per unit is about 1·92d., and the other, about ·6d. In the first, the annual cost of current is given as £30; in the second, £9 15s.

Renewals of tires account for at least £50 per annum; repairs of chassis, body, &c., estimated at, say, 3 per cent. of cost are £18; oil, grease, and cleaning may be put down as requiring, say, £5; and driver's wages are averaged at £80, which is on the high side.

The total costs amount to £340 per annum where the electric supply is taken at the higher figure; and £320, at the lower rate.

In these figures, it must be said that full allowance is very wisely made throughout, and they may be regarded as a maximum cost for the mileage given, and for reasonable care in working. They do not, however, give any extraordinary saving as compared with the average cost of a similar petrol car under like conditions, and although a small economy is possible, one would wish to see the difference so marked, that no doubt could exist in the mind of a prospective user.

Let us assume a first cost of, say, £800 for a petrol car; depreciation on this would be at least 20 per cent. per annum, or, say, £160.

Petrol for the same mileage would cost not less than £25; wages may be put at £102; tires the same, *i.e.*, £50, although their wear and tear is found to be considerably less with electric cars, owing to the more even torque; car repairs, oil, grease, and sundries, may be taken at £45, which makes a sum total of £382.

COMPARATIVE COSTS—ELECTRIC AND PETROL CARS.

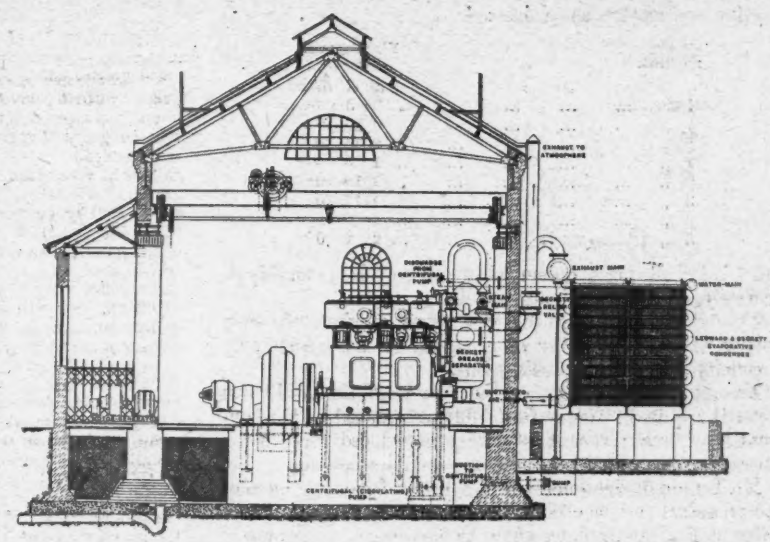
	Electric.	*Petrol.*
Depreciation of car	£88	£160
" " battery ...	67	—
Distilled water	2	—
Charging current or petrol ...	30	25
Tires	50	50
Repairs	18	40
Oil, grease, &c....	5	5
Driver's wages	80	102
	£340	£382

A saving of £40 or so is, of course, a consideration, but not nearly enough to cause a prospective user of one car only to decide upon electricity instead of petrol, in view of the extremely limited field of the one and the universal range of the other. For town work, however, the showing is good enough to warrant marked progress in this type of car, and we trust to see some rapid advances during the next few years, if all the reports one hears are well founded.

HOW TO CHARGE FOR ELECTRICITY.

"WHAT'S in a name?" said the great dramatist, and we reply, "A good deal more than some people think." Here is an instance, for example, in the "telephone" system of charging for electrical energy, which is in principle the same thing as the well-known maximum demand, but with a name designed for making the public more readily understand it, than has been possible under the technical explanations, which the "man in the street," who was not an electrical engineer, never could grasp.

The gas consumer, who has to be converted to the use of electricity, knows by experience that the number of feet of gas passing through his meter costs him so much per 1,000 all the year round, whether he takes little or much, and that he can, if he take the trouble, watch the consumption by reading the dials on the meter. He is not troubled with any scientific explanations as to the provision for standing charges, or cost of labour and material expended in production of the gas, and if you tried to explain that the establishment charges on a factory are represented by S on 10,000 articles per annum, and the cost per article by R



CROSS-SECTION THROUGH LOCHGELLY CO.'S POWER STATION, FIFESHIRE (p. 339).

and that the total cost is therefore $\frac{S}{10,000} + R$, the explanation would not be likely to forward your business. You might as well try to make a gas consumer understand how to measure a foot of something invisible.

There is simplicity in the telephone idea, because the public are familiar with the charge of a fixed price per annum and 1d. per call, so Mr. Seabrook says we will do the same; you shall pay so much a year, according to the extent of your requirements, and 1d. per unit. The difficulty will be in explaining how the fixed annual charge is arrived at, as it will differ according to the character of the installation.

Dealing with the small ordinary consumer, under the "telephone" system the proposed annual fixed charges may be based upon the candle-power of the lamps installed. Assume that a typical consumer has in his house 750 C.P. of metallic-filament lamps, or 250 C.P. of carbon-filament lamps, they would, in either case, require the provision of 1 KW. of power, and the telephone system of charge would be £14 per annum, and 1d. per unit for all units consumed. £14 means for one KW.-hour, a guaranteed maximum demand or fixed payment for 3,360 units per annum at 1d. per unit, besides the charge by meter of 1d. per unit for all current consumed.

In Mr. Seabrook's elaborate report to the Marylebone Electric Supply Committee he explains the proposed tariff by pointing out that 750 C.P. in metal-filament lamps is equal to 1 KW. of "maximum demand" or "power required," and consumes one unit per hour, and the same is required for 250 C.P. in carbon-filament lamps, one ordinary four-lamp radiator, two ordinary flame-arc lamps, four electric irons, or 16 small fans. He estimates that 750 C.P. would be approximately the "maximum demand" or "power required" of a 1,100 or 1,200 C.P. lighting installation.

Tariffs are specified for all classes of consumers, from 200 KW. "power required" down to $\frac{1}{10}$ KW., the minimum fixed annual charge ranging from £900 to £1 8s., with *pro rata* per KW. or part thereof per annum, and 1d. per unit for all units consumed.

The annual charge is payable in advance, and adjusted from year to year by the "power required" for the previous year, and necessary adjustments are provided for increase or decrease of installations after the annual payment is fixed. "For example, a consumer whose 'power required' for the past 12 months has been $\frac{1}{2}$ KW. would have the option of paying £7 down, plus 1d. per unit for all units consumed. That 'annual charge' holds good for 12 months.

At the end of the 12 months the 'annual charge' is again fixed for the ensuing 12 months. If the 'power required' has gone up or down during the year, the 'annual charge' will be altered accordingly for the next year."

In the case of small consumers, a special tariff is fixed for heating, cooking and other uses of electricity, excluding lighting and motors, as follows :—

Power required.	Fixed annual charge. £ s. d.
½ KW.	... 0 5 0
½ „	... 0 10 0
¾ „	... 0 15 0
1 „	... 1 0 0
2 „	... 1 10 0
3 „	... 1 15 0
4 „	... 2 0 0
5 „ and upwards	... 2 2 0

and 1d. for all units consumed, payable weekly, monthly or quarterly, as the Council may require.

This scale for heating and other uses of electricity only applies where the lighting of the premises is exclusively by electricity from the Council's mains.

Among the advantages of the system is that only one meter is required ; risk of bad debts is reduced by the payment in advance ; one set of wiring only is necessary, even where lighting, heating and cooking are all mixed up.

Mr. Seabrook does not believe in the flat-rate system of charge unless various classes of supply can be grouped, and a different flat rate fixed according to load factor, which would not be practicable.

In dealing with power demands for factories, the "telephone" system of charge is common enough.

For large consumers the Marylebone tariff is as follows :—

Power required.	Minimum fixed annual charge. £ s. d.
200 KW. at £4 10s. per KW.	... 900 0 0
175 „ £4 17s. 6d. „	... 853 2 6
150 „ £5 5s. „	... 787 10 0
125 „ £5 12s. 6d. „	... 703 2 6
100 „ £6 „	... 600 0 0
75 „ £6 10s. „	... 487 10 0
50 „ £7 „	... 350 0 0

Additional KW. *pro rata* per KW. or part thereof per annum, and 1d. per unit for all units consumed.

Terms.—Ten years' contract, and exclusive use of electricity for lighting and power (motors). The KW. charge payable annually in advance.

As an example of this tariff, a consumer of 200 KW. "power required" would pay £900 annually in advance, and £4 10s. per annum for every KW. above 200 KW., plus 1d. per unit for all units consumed.

BUSINESS NOTES.

(*Continued from page* 338.)

Catalogues and Lists.—MESSRS. PREVITE & Co., 2, Crosby Square, London, E.C.—16-page pamphlet, entitled "Trinidad Lake Asphalt," in which a great deal of interesting information is set forth regarding the concession for working the Pitch Lake, for which the Government has just granted a renewal, also concerning the constituent parts of the asphalt, the solubility of the latter, and other points.

MR. JAMES FERGUSON, 61, Pollok Street, Pollockshaws, Glasgow.—16-page illustrated catalogue, setting forth particulars of Ferguson automatic circuit-breakers, quick-break knife switches, replacement bridges and fuses, ironclad distribution boxes and other manufactures.

MR. S. N. BRAYSHAW, 2, Mulberry Street, Hulme, Manchester.—In response to requests that have been received for copies of the (1) Decimal Equivalents, (2) Millimetre Equivalents, (3) Centigrade and Fahrenheit Comparisons, appearing in his various catalogues, Mr. Brayshaw has prepared a considerable quantity of these in serviceable form, mounted on cards, varnished and strung for hanging up. We have received a set with the firm's name printed on very simply and unobtrusively. A set of the three cards will be sent free to anyone who would find them useful either for shop, office or drawing office use.

MESSRS. DONOVAN & Co., Barwick Street, Birmingham.—Price leaflet of 600-megohm grade non-Association cable ; also an illustrated price list of porcelain and brown-ware insulators and sundries.

MESSRS. PERKIN & Co., LTD., Lord Street Engineering Works, Leeds.—Leaflet on the use of disk grinders, with prices of 16 and 18-in. machines, also 12 and 14-in. sizes for bench or stand.

THE A.E.G. ELECTRICAL Co., OF SOUTH AFRICA, LTD., Caxton House, S.W.—Illustrated list (20 pp.), giving particulars, weights, prices, &c., of a variety of electric heating and cooking apparatus—water heaters, kettles, heating plates, workshop heating tables, hair-drying, soldering, and sealing apparatus, and cigar lighters.

Pumping Machinery for Alexandra Docks, Newport.—The contract has just been settled for an interesting pumping plant for the new Alexandra Docks of the Newport Docks Co. The pumping plant proper consists of two main pumps coupled direct to two triple-expansion steam engines, two separate 500-KW. generating sets being installed for lighting and power purposes. These pumps will be capable, when working simultaneously, of pumping 50,000,000 gallons of water from the River Usk into the dock extension in a period of five hours, the average quantity of water delivered during this period by one pump being 80,000 gallons per minute. Owing to the big quantities and comparatively low heads the pumps are dealing with, the average speed will be 90 R.P.M. The same pumps will be used for emptying the graving dock which will be built at a future date. In this case the pumps will work against a total head of 42 ft., and will each deliver an average quantity of 100,000 gallons per minute, running at speeds varying from 90 to 120. The maximum power required by each pump during this period will be between 1,100 and 1,200 B.H.P., placing them, it is claimed, amongst the biggest dock pumps built. Two schemes differing in principle have been carefully weighed with regard to this pumping plant. The question was whether the pumps should be driven direct by steam engines or whether electrically-driven pumps should be installed, and it was decided that the direct steam-driven pumps would give much greater economy under the existing conditions. This is due to the fact that steam engines are more adaptable to the different loads at the respective speeds which must be provided for in view of the varying heads against which the centrifugal pumps have to work. The main contractors for the whole of the scheme are Messrs. Cole, Marchant & Morley, of Bradford, while the pumps are being built to the designs of Messrs. Jens Orten-Boving & Co., of London, E.C., by Messrs. Willans & Robinson, of Rugby.

Germany.—A new company has recently been formed in Hamburg with a capital of £15,000 and the title Die "Telram" Gluhlampenwerke Gesellschaft, to manufacture a new metal-filament lamp known as the "Telram."

Fire.—An outbreak of fire occurred late on Saturday night at the works of the BRUSH ELECTRICAL ENGINEERING Co., at Loughborough, in the core drying shed next to the moulders' department, and soon after the arrival of the brigade the roof of the building collapsed. There was, however, very little woodwork about the place, and the firemen kept the blaze within bounds, and were able to leave the place after two and a-half hours' work. They had the assistance of the Falcon Works brigade, under Mr. Porter, and plenty of water was available, but the men were hampered by the darkness and by the clouds of steam as the water reached the heated steel work. The outbreak, it is thought, was due to the overheating of the drying flues.

Annual Sports.—To-morrow, Saturday, the fourth annual sports of the ROBERTSON AND OSRAM SOCIAL AND ATHLETIC CLUB will be held at the Latymer Upper School Ground, Ducane Road, Wood Lane, Shepherd's Bush, commencing at 2.30 sharp.

LIGHTING and POWER NOTES.

Australia.—At a recent meeting of the Electrical Association of Victoria, Mr. H. R Harper gave some details of the Melbourne City Council's electricity supply, and general progress in Victoria. He said that 21 electric supply orders had been issued ; the total capital expended on generating and distributing plant, including tramways, approximated £1,600,000, and the capacity was about 16,000 KW. of which 11,000 KW. was in the Metropolitan area. The gross revenue was about £250,000. British towns were about 80 per cent. ahead of Melbourne as regards electrical connections per inhabitant and 45 per cent. ahead as regards amount sold. Many Melbourne suburbs had no supply, including Howthorn, Williamstown, Footscray, Port Melbourne and Brighton, which had orders. Melbourne, with a population of over half a million, had a supply available for 260,000. Excluding power stations there were 20,000 H.P. generated by steam, 4,000 H.P. by oil and gas, and 4,000 H.P. in electric motors, being utilised in Melbourne.

The Electricity Committee of Pyrmont, N.S.W., has adopted plans for erecting a new generating station, at an estimated cost of £30,000. The new building is to be similar to the existing one, but providing larger coal storage. A further proposal to accept tenders amounting to £44,547 for a 4,000 KW. turbo-generator plant was considered, but in view of other tenders for higher-speed plants having been submitted, at £32,354 (which, however, did not comply with the engineer's specification as to speed), it was eventually decided to refer the matter back for the city electrical engineer to report.

Acton.—The annual abstract of the accounts of the Council for the year ended March 31st, 1909, shows that, although 70,597 units were sold more than last year, the total income was less by £118. This is accounted for by the discontinuation of the electric street lighting early in the year, the charge for which was at the rate of 4d. per unit, and the increase in the number of power units sold. The average selling price per unit this year was 3·33d., as against 3·88d. last year. Another effect of discontinuing the electric street lighting was to increase the production costs per unit sold, as the maximum demand on which payment was made to the Metropolitan Electric Supply Co. for the full year included the street lighting demand, which was only continued during the first six weeks of the year. The total cost to the Council of each unit sold, exclusive of loan charges, was this year 3·51d. and last year 3·48d. The deficiency, after providing for the repayment of loans and interest, was £4,943, as compared with a deficiency of £2,934 in the previous year.

The Electricity Committee on Monday night decided that a two-rate system of charging for electricity supplied to shopkeepers should be adopted, the price to be 7d. per unit for a supply used during a certain two hours of the evening, and 3d. per unit at all other times.

Brazil.—The cotton mills of the Companhia Americana at Rio de Janeiro are now being operated by electricity; the necessary power—about 1,350 H.P.—being supplied from the central station of the Rio de Janeiro Tramway, Light and Power Co., Ltd. The same undertaking is also supplying 800 H.P., to the cotton mills of the Fabrica Carioca. This only represents about half of the company's requirements and arrangements are in hand for the electrical operation of the whole of the plant.

The *Diario Official* of July 21st contains a copy of a decree transferring to the Companhia Brazileira de Energia Electrica the concessions granted to Senores Guinle and Cia. for the installation of electrical works at Alberto Torres, and the appropriation for electrical purposes of the water of the Rio Itapanhau, in the State of Rio de Janeiro.—*Board of Trade Journal.*

Brumby and Frodingham.—The U.D.C. has referred to a Committee an electricity scheme whereby it is proposed to take energy in bulk from the Frodingham Iron and Steel Co. at 1½d. per unit. The cost of the installation is estimated at £2,500, and the suggested charge to consumers is 6d. per unit.

Canada.—In connection with the new hydro-electric power line which is being built by the Provincial Government of Ontario, the construction of the stations at Dundas and Niagara is already proceeding at a good rate, and it is anticipated that they will be completed by December. The towers and telephone lines on the route of the transmission line are being rapidly put up. Two construction gangs are now working on the erection of towers, and a third will be added this week, when it is expected that it will be possible to erect 15 towers per day.

The large power companies at Niagara Falls are showing the most bitter hostility towards the Ontario Government's power policy, making desperate efforts to have the Power Bill disallowed by the Federal Government. Only a short time ago a delegation from the power companies waited on Sir Wilfrid Laurier, impressing on him their arguments for disallowal. They assert that the Act is *ultra vires* insomuch as it conflicts with vested interests. They argue that millions of dollars have been expended at Niagara by private power companies on the assumption that there would be no Government competition. Capital was obtained, mostly in England, to build the great works at the Falls. They argue that it is not fair to the shareholders, who put up their money in good faith, not dreaming of competition from the Provincial Government. Now, they say, that the several works have been completed and placed in practical operation, the Government steps in to build a transmission line in order to supply the south-western half of Ontario with power at cost. Whatever there may be in the arguments of the power companies, the Federal Government will certainly not disallow the Act nor interfere in any way with the power policy of Ontario. The people of Ontario are hailing with joy the advent of the Government's power policy, and the disallowing of the Act by the Federal Government, and the consequent stopping of the provincial power scheme, would create a rebellion in Ontario.

Continental Notes. — ITALY. — The Ascoli-Piceno hydro-electric installation on the Tronto River had its origin in a small supply for mill work, which some years ago was utilised in a reaction turbine of 200 H.P., driving a three-phase alternator at 240 volts, the pressure being raised in transformers to 15,000 volts for transmission: more recently in 1906 a canal was constructed to ensure a larger supply of water at all times. The total length of the new canal is 4,500 metres, and the discharge takes place where there is a difference in level of 40 metres between the head and tail races. The down-take pressure pipes are built up of riveted sheet-steel; the total length of the down-take is 71 metres. Three turbines, each constructed to give 620 H.P. at 600 R.P.M., have now been installed. They are coupled with an elastic coupling to the alternators. The alternators are all identical, star wound for 3,000 volts and 50 periods, with exciters mounted on the same shafts. The cables are taken to the controlling apparatus which is fixed in a compartment near the machine. The energy is raised to 15,000 volts, at which pressure it is transmitted to Ascoli-Piceno. There are three transmission lines, two of 3·5 mm. and one of 4·5 mm., the line being suitably protected with lightning arresters, both the Gola type and the Siemens type being used. The poles are usually of chestnut wood, 10 metres in height and 35 metres apart. At the distant end of the line the pressure is reduced to 240 volts for distribution.

SPAIN.—The municipal authorities of Mansilla de las Mulas (Province of Leon) have recently granted a concession for the electric lighting of the town during a period of 20 years.

TURKEY.—It is announced that the Turkish Ministry of Public Works has appointed a Commission to draw up the terms for a concession for the establishment and working of a large central electricity generating station in Constantinople.

SWEDEN.—The Drags Aktiebolag has decided to put down a plant to utilise certain available water power on the River Motala in the generation of electrical energy for lighting and power purposes at its cloth manufacturing mills at Norrkoping.

Cowdenbeath.—The T.C. has decided to apply for a provisional order for the extension of the burgh, and to embrace also electric lighting. The Fife Electric Power Co. intimated to the Council some time ago its intention of applying for power to supply electricity within the burgh, and the Council now proposes to ask it to withdraw the name of Cowdenbeath from the order.

Dudley.—A L.G.B. inquiry was held on Friday last relative to the application of the T.C. for loans of £6,000 for buildings and plant and £5,693 for cables. There was no opposition.

Glasgow.—Many interesting comments were offered when the annual report and accounts of the electricity department came before the T.C. for approval. The convener, in explaining the decreased revenue and the deficiency (reported in last week's REVIEW), pointed out that while that was partly due to depression, they attributed a considerable amount of the shrinkage to the benefaction bestowed in the reduction of rates conceded to certain classes of consumers and, in the second place, to the introduction and very extensive use of metal lamps. They were glad to think that there was a prospect of securing from the B. of T. protection against undue competition. Mr. Cosh considered it a very great injustice that wealthy people who required electricity for power purposes should be supplied with that commodity at a price considerably less than cost, and that shopkeepers should have to pay 3½d. for what cost 1½d., while other people got it for less than 1d. Mr. P. S. Stewart contended that, were it not for the large user, or firms using power, electric light would be very much dearer for shopkeepers. Mr. W. F. Anderson thought it too bad that the average consumer was compelled to burn his light for 700 hours before he got the reduction to the ¾d. It was from that class they got the sum of £119,000.

Hay.—The U.D.C. has formed a Committee to consider and report upon the possibility of adopting a scheme of electric lighting.

Kettering.—A L.G.B. inquiry was held on August 18th into the application of the U.D.C. for a loan of £2,000 for electricity purposes, viz., mains extensions, meters, public lighting, and the provision of two mechanical stokers. There was no opposition.

Kirkcaldy.—The T.C. is asking the consent of Dysart, an adjoining burgh, to include in a provisional order powers to supply electricity for lighting purposes in Dysart.

Londonderry.—In consequence of applications for power and lighting, the electrical engineer has been authorised to report on necessary extensions and the estimated cost.

Loughborough.—The accounts of the electricity department for the year ended March 31st last showed a profit on revenue account of £547, but owing to the heavy charges for loans, a grant of £1,500 had to be made from the general district fund, and an adverse balance was carried forward of £2,346. The total amount borrowed on the undertaking is £30,900.

Mansfield.—The T.C. has applied to the L.G.B. for a loan of £300 for water softening plant, and £200 for economiser extension at the electricity works.

TRAMWAY and RAILWAY NOTES.

Belfast.—At the weekly meeting of the Tramways and Electrical Committee the manager of the tramway system, Mr. Nance, recommended the abolition of the tramway centre poles in the interests of street traffic regulation. This was referred to the electrical engineer for report. A sub-committee was appointed to go into the question of the threatened litigation with Mr. Harrison over the Holywood tramway question and also to go into the proposed working of the Holywood line, the Bill for which has passed into law.

Canada.—A new electric railway will soon be commenced from Morrisburg to Ottawa. The company has been incorporated with a capital of £200,000. The power plants will be located at Morrisburg and Billings Bridge, Ottawa. Another line contemplated, called the Belt Line Electric Railway, covers practically the same route; but the Corporation of Metcalfe, in Carleton County, proposes to give the right of way to the company that begins work first.

Chile.—According to Reuter, the Government has decided on the electrification of 1,150 km. of railway, beginning as an experiment with 184 km.

China.—A scheme is on foot to construct an electric tramway from Swatow to the district city of Cheng-Hai, a distance of about 10 miles. According to the prospectus, the capital is to be $300,000, in $5 shares; the latter, however, are not being taken up readily. Two large river branches would require to be bridged, but otherwise the construction of the line would present no difficulties.—*Board of Trade Journal.*

Continental Notes.—RUSSIA.—Three new lines of electric tramways have just been completed and put in operation in the town of Saratov. There are now 26 km. of electric tramways at work in the town; there are still two lines to be converted to electric traction, of which one is nearing completion.

It is stated that negotiations in regard to the tramway reorganisation in St. Petersburg are being actively pursued by an international syndicate consisting of the A.E.G., Siemens & Halske, and the British Westinghouse Co., backed by the Deutsche Bank. Later reports mention competition by a syndicate headed by the Société Parisienne Electrique. The matter is referred to elsewhere in our columns.

GERMANY. — The Rheinisch-Westfalische Electricitätswerke Gesellschaft, of Essen, has secured a concession from the Provincial Government authorities of Solingen for the construction and working, during a period of 60 years, of five lines of electric tramways in the district.

ITALY.—A company has just been formed in Brussels, with a capital of £200,000 and the title La Société des Tramways de Palermo, to construct and work a system of electric tramways in the town of Palermo, Italy, as also a line connecting that place with Mondello, a distance of 10 km.

Glasgow.—The Postmaster-General has again communicated with the department a proposal to place small letter-boxes on cars. The Sub-Committee cannot see their way to recommend the T.C. to approve of the proposal.

Ilkeston.—According to a correspondent a strike of Corporation tramway employés is threatened, the men having applied for an increase in wages, which has been refused on the ground that the pay is equal to that given in other towns of equal size. Further, it is stated that the Ilkeston tramways are not a paying concern.

Kirkcaldy.—The agreement between Kirkcaldy and Dysart T.C. regarding the proposed extension of the Kirkcaldy tramway system to Dysart has been slightly altered, but it is believed it will now be acceptable to all parties.

Liverpool.—The tramways department of the Corporation carried out some smart work on Saturday night and Sunday in taking up and relaying the track with new double sets of rails, including junctions and points supplied by Hadfields, at the junctions of Dale Street, Castle Street and Water Street, where the main tramway traffic of the city converges. During Sunday the running of the trams at this spot was diverted, but the usual traffic was resumed on Monday morning.

London.—The evening of August 23rd saw the last of the Highgate Hill cable tramway—the first of its kind laid down in Europe—which is to give way to the electric car as soon as rebuilt by the L.C.C. The last few journeys were marked by a great demonstration on the part of the inhabitants living near, who crowded the cars, let off fireworks, and sang "Auld Lang Syne."

Following the example of the District Railway, the Charing Cross and Hampstead tube line is being provided with a morning and evening service of non-stop trains.

Morecambe.—The T.C. has decided to double the tramway track to afford greater facilities for the working of the system.

South Africa.—At a special meeting of the East London T.C. held on July 28th, it was resolved to re-lay the tram-tramway track at an estimated cost of £8,500. Recent attacks on the electrical engineer, which led to his resignation being tendered, have caused much public feeling, and a petition is being largely signed asking the Council to retain his services till the reorganisation scheme is completed.

At the last meeting of the Johannesburg T.C., the question of the alteration in tramway fares came up for discussion. The Committee reported against the proposal of the introduction of 1½d. stages by a majority of one, so that the fares will remain as at present. The fact that last year the tramways showed a profit of £40,000, and that a larger profit was anticipated this year led to a demand by a great many for the reduction, but the fact of the heavy losses in previous years carried greater weight.

Wallasey.—The Bill providing for the construction of the extended tram route to Wallasey village from Seacombe having just received the necessary sanction, the U.D.C. will at the next Council meeting consider the question of the method of putting its powers into effect. In the Committee there is a controversy raging as to whether the Council should undertake the work or whether it should be let out to contract. The tramway system already in operation was constructed by the Council's own department.

TELEGRAPH and TELEPHONE NOTES.

Brazilian Wireless Stations.—The Government contemplates the erection of a high-power wireless station on Fernando de Noronha, as well as a small installation to communicate with Pernambuco. Another station will be erected on Babylonia Hill, Rio de Janeiro.

Cable Interruptions and Repairs:—

	Interrupted.	Repaired.
Tangier-Cadiz	May 19, 1909	
Tourane-Amoy	June 17, 1909	
Assab-Perim	July 8, 1909	
Gibraltar-Tangier	Aug. 7, 1909	
Melilla-Chafarinas	Aug. 7, 1909	
Cueta-Tangier	Aug. 7, 1909	
Corfu-Trieste	Aug. 16, 1909	Aug. 23, 1909
Dakar-Conakry	Aug. 20, 1909	

Fire at a Marconi Station.—According to the daily papers, a fire occurred at the Marconi wireless station at Glace Bay, on Saturday last; the repairs will occupy six weeks, and messages are being sent *via* Cape Cod in the meantime.

Indo-Burmah Telegraphs.—The work of improving the telegraph between India and Burmah, started two years ago, is nearly complete. The Chittagong line and that *via* Assam have been overhauled; the latter is now the main route. The Brahmaputra is crossed by an overhead suspension, and the only submerged cable is at the Ganges crossing. It is stated that the line will not be quite satisfactory until it is possible to run it along a railway.

Portsmouth Municipal Time.—The Telephone Committee has under consideration a proposal to take £300 from the reserve fund for the provision of a Magneta clock system in the borough. It has been decided to apply for the sanction of the L.G.B.

Rand Telephones.—The installation of telephones on the Witwatersrand Gold Mines is likely to become very general in application, and since the recent adoption of an underground telephone system in the shafts and various drives of the Roodepoort Central Deep Gold Mine, it is rumoured that a telephone installation will be generally carried out on the Randfontein estates. There is also a probability of the Langlaagte Gold Mine following suit, as well as various other mining properties.

South African Wireless Stations.—Reuter's Agency announces that active steps are being taken to erect wireless installations along the South African coast. The Government of Natal are in treaty with the Home Government with the idea of erecting such a station on the bluff at Durban, and the scheme will be extended to a system of stations between Cape Colony and Delagoa Bay.

Spanish Telegraphs and Telephones.—*Le Boletin Oficial del Cuerpo de Telegrafos* of Spain publishes a law according to which the Government of Spain has been authorised to spend 10,000,000 pesetas in the reorganisation and development of the telegraph and telephone services. Of this sum 1,895,670 pesetas will be expended on landlines, 2,116,000 on submarine cables, and 106,626 on telephone instruments. 4,618,607 pesetas will be allocated to the extension of telephones and telegraphs, and will include the cost of connecting 382 offices, where there are more than 4,000 inhabitants, with the telegraph system, and 846 offices, where there are less than 4,000 inhabitants, with the telephone system, as well as 1,235 localities where the inhabitants number less than 2,000. The remaining 1,263,096 pesetas will be devoted to the construction of telegraphs to places willing to furnish the necessary poles, and it is calculated that of these there are 1,235.—*Journal Télégraphique.*

Telegraphic Interference.—The Western Union, the Postal Telegraph and Cable Co., and the Lake Shore and Michigan Southern Railroad Co. have been proceeding against the Chicago, Lake Shore and South Bend Traction Co., claiming that the alternating current which is used to work the cars of the traction company seriously interferes with the working of the telegraph companies' wires, rendering them at times useless between Chicago and New York. The telegraph companies' suit was for an injunction, but the judge decided against them, and an appeal has now been lodged. The system of the traction company consists of a single-phase road 77½ miles long, with operating potential on the trolley wire of 6,600 volts. For some part of the way the lines of the various concerns run parallel.—*Telegraph Age.*

Wireless Communication with Balloons. — The *Zeitschrift fuer Schwachstromtechnik* refers to experiments made in in Belgium with wireless in communicating with balloons which recorded signals from the Eiffel Tower and the Palace of Justice at Brussels. This, the journal states, will be of great benefit to aerial navigators, who will not only be able to furnish observations to land without descending, but will also be able to receive directions for their journey or meteorological warnings, enabling them to seek safety before the approach of storms.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Melbourne.—2,550 common battery telephones and protectors for the P.M.G. See "Official Notices" August 20th.

Ballinasloe.— September 10th. The Committee of Management of the Ballinasloe District Lunatic Asylum wants tenders for the supply and erection of overhead cables. See "Official Notices" July 30th.

Belgium.—September 1st. La Société Nationale des Chemins de Fer Vicinaux, of Brussels (14 Rue de la Science) is inviting tenders for the contract for the supply and erection of the overhead equipment of the Trazegnies-Anderlues electric railway.

Brazil.—October 5th. Tenders are being invited by the municipal authorities of Corumba (Province of Matto-Grosso) for the establishment of a central electric lighting station in the town.

Edinburgh.—September 4th. The Corporation invites tenders for a motor-alternator and for an electric lighting installation. See "Official Notices" August 6th.

Handsworth.—August 30th. Steam coal for the electric generating station of the U.D.C. F. A. Nixon, electrical engineer.

Leeds.—September 7th. Paper-insulated cables for the E.L. Department. See "Official Notices" August 13th.

Leyton.—September 7th. Public lighting lanterns with clock switches for incandescent electric lamps, for the U.D.C. See "Official Notices" August 13th.

September 7th. Electric light wiring and fittings for the Public Offices; extension for the U.D.C. See "Official Notices" August 20th.

London.—L.C.C.—September 14th. The L.C.C. wants tenders for the supply and laying of 6½ miles of 0·075 sq. in. three-core cable and 46 miles of single-core cable, telephone cables, &c.; the supply of 50 tramway feeder pillars; laying 16 miles of stoneware ducts; and the supply of 440,000 stoneware ducts. See "Official Notices" August 6th.

Poplar.—September 8th. Electrical supplies for a year for the B.G. G. H. Lough, Clerk, 45, Upper North Street, Poplar, E.

September 1st.—Miscellaneous stores and electrical accessories for the Metropolitan Asylums Board. See "Official Notices" August 20th.

L.C.C.—September 21st. Two 500-kw. and 150 kw. motor-generators, also high and low-tension switchgear, for sub-stations; steam and other piping, valves &c., for Greenwich generating station. See "Official Notices" to-day.

Plymouth.—September 2nd. Steam turbo-dynamo for the Corporation. See "Official Notices" August 13th.

Servia.—September 14th. The Servian State Railways authorities in Belgrade are inviting tenders for electrical plant required in connection with the new installation at the Segme mines. The plant required comprises a winding engine, centrifugal pumps, signals, and the necessary electrical conductors.

Spain.—September 2nd. The Artillery Authorities at Seville are inviting tenders for the supply of a 15-kw. continuous-current dynamo and an 18-h.p. electric motor.

Warrington.—September 10th. Electrical requisites for six months, for the B.G.; A. Bottomley, clerk, Bewsey Chambers, Warrington.

West Ham.—September 2nd. Electrical fittings for a year, for the B.G. Thomas Smith, clerk, Union Road, Leytonstone, N.E.

Wishaw.—August 30th. Three-wire d.c. switchboard for the Craigneuk sub-station, for the Electricity Department. See "Official Notices" August 13th.

CLOSED.

Dundee.—Messrs. Maxwell, Son & Co., Dundee, have secured the contract to install electric light in connection with the Submarine base. The contract comprises the illumination of the officers' quarters, outbuildings, and lavatories, and the providing of extra lights round the dry dock. The same firm are to carry out the installation in connection with the Corporation's new Central Reading Room.

Glasgow.—The Tramways Committee has recommended the following offers for acceptance:—

Steel traction poles.—Wilson's & Union Tube Co., Ltd.
Phono trolley wire.—Equipment & Engineering Co., Ltd.
H.D. copper trolley wire.—Standard Cable Manufacturing Co., Ltd.
Switch panel.—British Westinghouse Electric and Manufacturing Co., Ltd

When the recommendation of the Libraries Committee that the offer (£2,799) of Messrs. Allan, Arthur & Ure for the electric lighting of the new Mitchell Library came up for confirmation at the Town Council meeting, a discussion arose as to the method by which the tenders had been obtained. Mr. Battersby, the convener, explained that the Committee had been advised by their own electrical experts that the most satisfactory way was to take six or seven firms who did that class of work and provide them with specifications. That course was followed. Seven firms were invited to tender, six did so, and the lowest offer was that of Messrs. Allan, Arthur & Ure. Mr. M'Millan moved that the minute be taken back. He characterised the Committee's action as unfair, and held that public work should be put upon the public market. The minute was, however, subsequently approved.

India.—An Indian exchange says that the Bengal-Nagpur Railway Co. have ordered for trial purposes 100 cells from the Chloride Electric Storage Co., Ltd.

London.—The following tenders have been accepted for the Government Departments named:—

War Office.

Electric cable.—Callender's Cable and Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; India-Rubber, Gutta Percha and Telegraph Works Co., Ltd.; Johnson & Phillips Ltd.; Siemens Bros. & Co., Ltd.
Copper conductors.—W. F. Dennis & Co.

General Post Office.

House telephone apparatus.—Gent & Co., Ltd.
Cable (paper core).—Henley's Telegraph Works Co., Ltd.; British Insulated and Helsby Cables Ltd.
Cable, submarine.—Siemens Bros. & Co., Ltd.
Bell receivers.—General Electric Co., Ltd.
Portable telephones.—British L. M. Ericsson Manufacturing Co., Ltd.
Wire, copper, hard drawn, 800 lb.—British Insulated and Helsby Cables Ltd.; T. Bolton & Sons; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., incorporated in the London Electric Wire Co. and Smiths, Ltd.
Electric lifts at Post Office telegraph stores, Cherrywood Road, Birmingham.—A. and P. Steven, Glasgow.
Telephone service and equipment, extension at Ealing Telephone Exchange.—Western Electric Co.

Manchester.—The Corporation Tramways Committee has placed a contract with Mr. William Stabway for a 40-45 h.p. Rynknield petrol motor-car for use as a tower wagon.

Middlewich.—The Electrolytic Alkali Co., Ltd., have placed an order with the Key Engineering Co., Ltd., for a 500-h.p. Ehrhardt & Sehmer gas engine for driving an electric generator at their works.

Rawtenstall.—The T.C. has accepted the tender of Mr. J. W. Kidd for the installation of the electric light at the Municipal Offices.

Sheffield.—The Education Committee on Monday accepted the tender of Messrs. Hall & Matthews, of Sheffield, for installing the E.L. at the new hostel, at £127. That of the Corporation Electricity Department, at £155, was recommended for acceptance. There were 13 tenders, the highest being £328, and the lowest £94!

NOTES.

Parliamentary.—The Electric Lighting Acts (Amendment) Bill.—The House of Commons again debated this Bill on 20th inst., and, after making further amendments, allowed it to be read a third time. The following addition was made to Clause 6:—"(4) Nothing in this section shall enable the Board of Trade, without the consent of the undertakers within whose area of supply the premises are situate, to give such permission as aforesaid to any undertakers where the last-mentioned undertakers are by any Act of Parliament specifically prohibited from supplying electricity within the area of the first-mentioned undertakers."

Clause 24, as we gather from the *Times* report, was struck out, and an amendment was made to Clause 26, stating that the expression "undertakers" meant any local authority, company or person authorised to supply electricity "to whom the E.L. Acts apply."

The London Electric Supply Bill.—In his "Slaughter of the Innocents" announcement last week, Mr. Asquith stated that the London Electric Supply Bill would have to be withdrawn.

Points in Favour of the Electromobile.—In a leaderette appearing in the New York *Electrical World* under the title "The Blessed Noiselessness of the Electric Vehicle," our contemporary interestingly and effectively sings the praises of the electromobile in the following words:—

"If the noise of machinery means waste, as engineers contend, the ordinary gasoline automobile must be a wasteful device indeed. In the campaign against the noise of city streets the gasoline car is often a conspicuous offender, and it contrasts most unfavourably with the latest types of electric vehicles, which are almost noiseless. Imagine a darkened upper room in a city house in which a father is anxiously regarding a sick child.

The curtains are drawn, but the windows must be left open to admit the summer air. The doctor says that the little sufferer must have rest and quiet, and the parents are doing their best to secure this condition without removing their little one from the comforts of home. There are flowers in the room, and the restful hum of an electric fan is heard. The child has fallen into a troubled sleep, and the father is regarding her anxiously. Suddenly, whir-r-r-r, chug, chug, chug—the distracting noise of a big gasoline automobile is heard outside. It sounds like an explosion and is continued for some time. The patient jumps up with a start; its dearly bought rest has vanished, and slow tears course down the cheeks of the child. The father has an impulse to tear that machine into a thousand fragments if he could get at it. This is no imaginary picture, but fact.

"No such charge as this can be brought against the electric machine. 'Joy riders' make no use of the electric vehicle. The speed mania does not seize hold of those who manage the safe and sane electric car. The latter does not drip gasoline on the street, neither is it characterised by an offensive odor. Quietly, steadily, but with strength and power, electricity does its work whether in propelling the carriage which a woman or even a child may operate, or driving the attractive delivery wagon or the heavy truck. The opprobrium which attaches to the reckless driving of automobiles is directed almost entirely against the gasoline cars, and rightly so, for very few accidents are to be attributed to the easily controlled machines of the electric type. In a few places in this country automobiles are forbidden the privileges of the street within municipal limits; but it will be well for the exasperated city authorities to make a distinction in favour of the electric vehicle, for it is not that type of car that has brought reproach on automobilism."

The virtues of the electric vehicle have been recognised by the powers that be in England by allowing electric carriages to be run in the parks at hours when cars using other forms of power are prohibited—much to the chagrin of those interested in the non-electric automobile trades. But with all this governmental patronage the electromobile does not make anything like the headway that it should do here. On the point of noiselessnese, the annoying "whir-r-r-r, chug, chug, chug" of the doctor's own motor-car is not unknown to render his prescription of "perfect quiet" unavailing at times. The motor-car is undoubtedly a boon to the medical man—but it ought to be electric!

Appointment Vacant.—A manager is wanted for the Ilkeston tramways and electricity department (£200). See our advertisement pages to-day.

Electrical Fatalities.—A boy aged six took a short cut across the N.E. electric railway one day last week while returning from school, when he fell on the live rail where he lay until an electric train threw him off. "Accidental death whilst trespassing on the electric railway" was the verdict of the jury.

On the 19th inst. an inquest was held at Pyle, Glamorgan, into the death of Owen David and David Thomas, two colliers, who were killed recently at the Cribbwr Fawr colliery by touching the live armouring of a cable. According to the daily Press, Mr. Robert Nelson, Home Office expert, expressed the view that the accident was caused by inefficient earthing, and he suggested an improvement. Another witness, Joseph Llewellyn, said he saw David clasping the electric cable, and rushed forward. He caught hold of him by the waist and dragged him away. As he was doing so their faces came in contact, and witness received a shock which rendered him unconscious.

Engineering Day at the White City.—We have received particulars of arrangements that have been made for holding an Engineering Day at the Imperial International Exhibition at Shepherd's Bush on Saturday, September 4th. Mr. W. Worby Beaumont is the chairman of the Joint Organising Committee and Mr. W. Yorath Lewis is honorary secretary. The affair is being organised by the General Mechanical Engineering Committee, the Mining and Metallurgical Committee, the Building and Engineering Construction Committee, the Institute of Marine Engineers and the Cornwall Mining Committee. The Lord Mayor of London will preside over the proceedings. The programme includes a round of visits for inspecting the construction and operating mechanism of the Flip-Flap, the Wiggle-Waggle, the Witching Waves and whatever else you will in a long list, including such prosaic things as gas engine plants driving printing machinery and refrigerating plant, and the electrical sub-station; the exhibits in the Machinery Hall and other objects of engineering interest that have been brought together for the occasion will be on view. Between the hours of 2.45 p.m. and 7 p.m., no fewer than half a dozen papers and lectures will be delivered in the Congress Hall, as well as there being half-an-hour's interval for a reception at 5 p.m. by the Lord Mayor. In these discourses, Mr. A. Steiger will talk of "Water Power and Turbines"; Mr. J. McLaren will dilate upon "The Extended Uses of Electricity on Board Ship"; "The Treatment of Marine Boilers on Long Voyages," will be the theme of Mr. H. Ruck Keen; "Large Gas Engines" will be lectured about, with lantern slides, by Mr. Percy R. Allen, and the two remaining subjects relate to drawings by, and for, engineers and architects. The last paper is, "according to programme," to commence at 7 p.m., after which, at 7.45 p.m., there is to be a great "Engineering Day Banquet," for which tickets up to 500 are obtainable for 5s. each; anybody desiring to purchase tickets should apply to Mr. Lewis at the Exhibition; and as the printed programme says that a large number have already been applied for, you had better write soon.

From all the foregoing, we are told, it is hoped that "some good may result in thus starting a movement which might well be extended with the object of securing concerted action and more effective results by the numerous technical institutions." We are also told that "the idea of, in this way, endeavouring to bring together the members of the numerous societies relating to engineering seems to be heartily approved by several sections of the engineering community." This is an admirably guarded and qualified statement. The "architectural features of the remarkably beautiful buildings" are mentioned in the list of attractions for this day as appealing to architects and those interested in the building trades. "All interested in engineering work are cordially invited to attend, with their friends, including ladies," and so we suppose are all and sundry who care to pay for admission to the Exhibition. From what we have given above, it will be seen that those who desire to do so can spend a very busy Saturday half-holiday on September 4th, and if they have time, can think something about that question of more concerted action. We observe from the daily Press that the Institutions of Civil and Electrical Engineers and the M.E.A. are to be represented as institutions, but the programme does not say anything about these organisations, and we are not aware that the Institution of Electrical Engineers as a body is in any way identified with the event, whatever may be the part played by individual members.

Legal.—In *re* The Phosphor Bronze Co., Ltd.—Bruce *v.* The Company.—In the Vacation Court on Wednesday last this debenture-holder's action came before Mr. Justice Hamilton on a motion by the plaintiff for the appointment of a Receiver and manager of the defendant company. Counsel for the plaintiff stated that he had come to an arrangement with the defendant company, who were willing that his Lordship should at once pronounce the usual debenture decree. Under those circumstances, with his Lordship's sanction, it was proposed to take the usual order for accounts and inquiries and for the appointment of a Receiver and manager. He asked that the gentleman appointed should have liberty to act at once and to appoint a sub-manager. His Lordship made the order as asked.

Inquiries.—Names are asked for of manufacturers of Rheostene and Resista resistance materials.

Anglo-Japanese Hydro-Electric Power Scheme.—Our correspondent at Ottawa, Canada, writes:—

"The Canadian Trade Commissioner at Yokohama, Japan, advises the Department of Trade and Commerce here, that there will be established in London a company which will undertake the work of floating a loan in order to supply funds to the Anglo-Japanese Hydro-Electric Power Co. From the statement made by Mr. Sonoda, Mr. Masuda, and Baron Shibusawa and Marquis Katsura, it has, however, been ascertained that the aforesaid company will be established in Canada under the Canadian law. The Commissioner says that Marquis Katsura asked these financiers the reason why London business men had chosen Canada instead of London, and that Mr. Sonoda explained that in England the registration fee was excessive, whereas in Canada, which encourages industrial enterprises, the various taxes, including registration fee, were insignificant, and that, moreover, the Canadian law recognised the establishment of a company whose object it was to advance loans. These facts had induced the British capitalists to choose Canada for the establishment of the headquarters of the company.

"The views expressed by the promoters are that in accordance with the demands of the age a hydro-electric enterprise should be inaugurated by means of foreign capital, so that the Government is not likely to object to the scheme. Apparently the Government welcomes the enterprise. Sir Edward Strassay, accompanied by an expert, goes to Japan from London some time this month, when they will inspect several rivers capable of being utilised for the generation of electricity. The subscribers may be entitled to become shareholders of the Canadian Co. and of the Anglo-Japanese Hydro-Electric Co., which will be established in Japan at the same time."

Information Wanted re Life in Aden.—"Ignoramus" writes:—"Having regard to the bad state of things in this country, and seeing the large number of engineers who now seek situations abroad, I have under consideration the offer of a berth in Aden. May I trespass upon your valuable space in the hope that among your numerous readers there may be one who has had experience of this part of the world and who will be generous enough to give me some information as to (1) the cost of living; (2) the cost of clothes and other necessities; and (3) the sort of climate to be expected."

He Applied for a Reward.—We are indebted to an Australian correspondent for the following copy of an amusing letter received by him from one who, out of the fulness of his heart and the inner recesses of his fertile brain, desired to confer a boon upon his fellow countrymen in Australia—for a reward. All we are sorry about is that our correspondent did not send us a copy of his "sympathetic" reply! We believe that the extermination of rabbits electrically has been suggested and tried at least *once* already. That remark about the "stored electricity *promised* by Edison Co." is good, and seems to stamp the writer as not being such a child in electrical matters as some parts of his appeal might lead one to suppose:—

"Dear Sirs, I note from the "Bega" Budget a paragraph that your firm are "exponents" of all that can be done by electricity heating and iron to driving a motor or lighting a palace. Well,

the idea came into my head that electricity might be utilised to kill rabbits, and I applied to the Premier for a reward for the scheme. Can you assist me in any way. My idea was to run two parallal lines of wire on insulating cups about ½ in. apart, under a fence about 4 in. from the ground, and that rabbits passing under would join the circuit and be killed.

"Some people say the plan was tried years ago and failed (if so, I never heard of it), others that the wires would be dangerous to human beings (but the wires need not be long, say, 200 yd., and could easily be guarded during three or four hours after dark). Others say the wires could not be charged sufficiently owing to excessive leakages (I am not aware if this is so).

"Can you tell me if it can be done, and if it would be very expensive. I note that a dynamo is not a very costly thing, but there may be other reasons I am not aware of, such as weight, 1 cwt. Doubtless there would arise a considerable demand for dynamos, and this might be worth the attention of your firm. My view was that each instrument should be handled by a Government expert, and moved from place to place to kill rabbits.

"Trusting you will give me a sympathetic reply, I remain, Sirs, yours faithfully, ——

"P.S. Would the stored electricity promised by Edison Co. be likely to be of assistance?"

Accident.—While fixing electric light wires at the new Council Secondary Schools at Croydon on 18th inst., the scaffolding collapsed, and two men (Edwards and Price), employed by Mr. Ernest Price, electrician, were thrown to the ground. They were both removed to the hospital with broken legs.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—On 19th inst. MR. F. E. NEWTON, mains superintendent, was recently the recipient of a barometer, bearing a suitable inscription, given by the staff of the electricity department, Partick, Glasgow, on the occasion of his marriage. Mr. Sillery, burgh electrical engineer, made the presentation, and Mr. Newton replied.

Tramway Officials.—The Corporation tramway staff at Portsmouth has presented a set of silver fish knives and forks to MR W. R. SPAVEN, general manager, and Mrs. Spaven, on their silver wedding.

In this column last week MR. MEDCALF was incorrectly described as general manager of the Swindon Corporation tramways. His title, we understand, is "tramways manager."

MR. J. K. NORTH, late tramway manager at Rawtenstall, has been presented by the employés with a framed photograph of themselves.

General.—As noted elsewhere in this issue, MR. O. H. BISHOP, for many years, and until recently, sales manager to the Edison & Swan Co., has now joined his interests with those of the E.M.F., Ltd., of Ironmonger Lane, E.C., of which company he has become a director. We are asked to state that he will welcome communications at the above address from old friends and supporters.

MR. T. TOMLINSON, 16, Beresford Place, Dublin, is now honorary secretary of the Dublin Section of the Institution of Electrical Engineers.

MR. C. G. TREVETT, sole partner in the firm of Green & Trevett, electrical engineers, Cape Town, having taken up a position on the engineering staff of the Rand Mines Power Supply Co., Johannesburg, the business of the firm has been taken over by MR. E. A. SHAW, A.M.I.E.E., the manager of the late firm.

The *London Gazette* contains the following notices regarding appointments in the Territorial Force (Royal Engineers):—

"London District Telegraph Companies, Royal Engineers (Army Troops).—LIEUT.-COL. A. BAIN is granted the hon. rank of Colonel (March 31st, 1908).

Northern Cable Telegraph Company, Northern Command Telegraph Companies, Royal Engineers (Army Troops).—C. WRIGHT to be Second Lieutenant (July 2nd).

Electric Lights Company, Cinque Ports (Fortress).—H. U. HOOPER to be Second Lieutenant (to be supernumerary) (July 15th).

Cornwall (Fortress).—MAJOR and HON. LIEUT.-COL. C. H. PAYNTER, Retired List, Militia (Major, retired pay), to be Major, with the hon. rank of Lieut.-Col. (June 23rd).

Electric Lights Companies, Hampshire (Fortress).—SECOND LIEUT. R. GUEST resigns his commission (July 7th)."

The *Australian Mining and Engineering Review* reports that MR. A. FALKENBACH, A.M.I.E.E., who has been for the last three and a-half years chief electrical engineer at the Deep Leads Electric Transmission Co., Ltd., Charlotte Plains, Victoria, has resigned to take up a similar position with the Ross Goldfields, Ltd., Hokitika, New Zealand, where a plant is being erected for the transmission of current from Kanieri Forks to the mine at Ross, a distance of 25 miles, the transmission pressure being 24,000 volts. Mr. Falkenbach left for New Zealand at the end of July.

The *Times* special correspondent at Teheran, in reporting the kidnapping of MR. ALAN WRIGHT, of the Imperial Bank of Persia, by brigands while travelling between Kerman and Yezd, states that Mr. James, of the Indo-European Telegraph Department, who was working on the line, went to Mr. Wright's assistance, and effected his release on Saturday. "Both, however, are still in an awkward situation, as the road in either direction is infested with robbers." Later information reports that they are in a perilous position.

On the occasion of his retirement on a pension after 43 years' service, MR CHARLES PUGH, chief telegraph department of the Newark G.P.O., has been presented by the inside and outdoor staff with a barometer.

MR. VINCENT S. ALLPRESS, M.I.C.E., consulting electrical and mechanical engineer, asks that in future all letters and correspondence, &c., should be addressed to him either at 39, Victoria Street, Westminster, or to Southwick, Sussex.

Obituary.—The death of THOMAS LIVESEY, late parcel clerk to the Blackburn Corporation tramways, by whom he has been employed for the past seven years, took place on Sunday, August 15th, after only a few days' illness, of pneumonia. Wreaths were contributed by the inspectors, drivers, and conductors, and the parcel and clerical staffs. The funeral took place on the following Thursday, when about 60 drivers, conductors, and parcel boys (in uniform) walked ahead of the hearse to the cemetery, as a mark of esteem for the deceased.

MR. HOLMES (WILLIAM, not SYDNEY), whose death from drowning was alluded to in our last issue, was not traffic superintendent under the Rhondda Tramways Co., being a motorman in their service. MR. GEO. E. RODDY is the company's traffic manager and superintendent. We are pleased to insert this correction.

The death is announced of MR. JOHN WILSON, of the Dundee Corporation electrical department. Death took place suddenly on 17th inst.

An evening paper says that MR. HOWARD THURSTON, who held a position in the service of the Eastern Telegraph Co., has been found shot on the western coast of Africa.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Imperial Lamp Works (Brimsdown), Ltd. (107,306).—Particulars of £40,000 debentures created August 4th, 1909, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £15,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

CITY NOTES.

Dublin and Lucan Electric Railway Co., Ltd.—Mr. W. Mooney moved the adoption of the half-yearly report at the meeting held on August 19th. He said that the affairs of the company continued in a prosperous condition. The receipts were £3,351, or 8 per cent. (£242) better than for the corresponding period of 1908. The expenditure was less by £108. The line and rolling stock had been maintained in the highest state of efficiency, and the goods and passenger traffic had been carried on with the utmost regularity. There was a regular half-hourly service from both ends of the line, with occasional specials. Their goods and parcels traffic had developed largely, and he hoped would continue to grow. The preference dividend required £475, £250 had been placed in further reduction of electrical equipment debt, and £429 was being carried forward. They were applying for an Order in Council sanctioning the working of a portion of the proposed extension from Lucan to Leixlip. The report was adopted.

Claud Hamilton, Ltd.—At the general meeting, held in Glasgow, Mr. Alex. J. Fergusson, C.A., chairman, presided and moved the adoption of the report, which recommended a dividend of 6 per cent. on the ordinary capital of the company, after making provision for depreciation, carrying substantial amounts to the various reserve funds and paying the dividend on the 5 per cent. preference shares. Mr. Geo. M'Gregor seconded, and the proposal was adopted unanimously. Mr. Alex. J. Fergusson was re-elected a director.

Blackpool and Fleetwood Tramroad Co.—The half-yearly meeting was held on Thursday last week. The accounts showed receipts to be £11,794, on the revenue account the charges being £8,162. The sum of £4,657 had been spent in the purchase of materials for the renewal of six miles of single line. A dividend of 4 per cent. was announced, £1,250 being placed to the reserve fund.

Prospectus.—*Sungei Liang Rubber Co., Ltd.*—This company has been offering 35,000 shares of £1 each for subscription at par. The company acquires rubber estates in the State of Pahang, Malay States, whereon 32,000 trees are planted.

Ascot District Gas and Electricity Co.—The directors have declared an interim dividend of 5 per cent. per annum (5s. per share), less income-tax, for the past half-year.

Aberdeen Suburban Tramways Co., Ltd.—For the half-year ended July, 1909, the directors recommend a dividend of 2 per cent., carrying forward £527.

United Electric Car Co., Ltd.—A dividend of 2½ per cent. on the ordinary shares for the year is announced.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Ins.
Aberdeen	Aug. 18	3,626	+ 322	11	17,718	— 505	..	..
Ayr	„ 21	1,098	+ 6	14	5,813	— 226	8	..
Bath	„ 18	1,982	+ 153	33	25,488	+ 1,097	..	..
Belfast	„ 20	7,769	+ 571	19	78,951	+ 3,586	37	..
Birkenhead	„ 22	2,227	+ 73	20	22,936	— 442	18·63	..
Birmingham Corp.	„ 14	12,578	+ 88	20	129,207	+ 3,437	..	..
Blackburn	„ 18	2,535	+ 91	21	23,982	— 852	13·97	..
Blackpool-Fleetw'd	„ 21	4,168	+ 211	7	11,482	+ 180	..	..
Bolton	„ 22	4,884	+ 81	21	49,529	— 790	42	..
Bournemouth	„ 18	5,098	+ 314	20	25,938	+ 54	21·96	..
Bradford	„ 14	11,028	+ 612	19	97,470	+ 1,671	54·9	..
Brighton	„ 22	2,725	+ 188	21	21,913	+ 806	9·5	..
Bristol	„ 20	11,931	+1,884	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	Aug. 13	447	+ 22	32	6,937	— 115	3·65	..
Barnsley	„ 13	354	— 32	„	5,331	— 270	..	..
Barrow	„ 13	653	+ 8	„	7,370	— 560	5·37	..
Cavehill	„ 13	294	— 28	„	2,819	— 154	..	..
Devonport	„ 13	891	— 298	„	11,880	— 2,847	8·85	..
Gateshead	„ 13	2,123	+ 5	„	21,852	— 810	11·25	..
Gravesend	„ 13	569	— 14	„	6,633	— 172	6·5	..
Greenock	„ 13	1,436	+ 174	„	17,378	+ 397	7·25	..
Hartlepool	„ 13	696	+ 18	„	7,446	— 204	6·72	..
Kidderminster	„ 13	456	+ 3	„	3,475	— 238	..	..
Leamington	„ 13	554	+ 27	„	5,558	+ 173	..	..
Merthyr	„ 13	545	+ 42	„	6,375	+ 85	2·9	..
Metropolitan	„ 13	15,576	+ 935	„	169,289	+15,014	22	..
Middleton	„ 13	889	— 49	„	10,816	+ 881	3·5	..
Mid. Joint Com'tee	„ 13	13,164	— 207	„	182,136	— 4,478	..	..
Oldham—Ashton	„ 13	1,231	— 50	„	17,895	— 1,134	9·13	..
Peterborough	„ 13	328	— 34	„	3,754	— 339	5·31	..
Potteries	„ 13	8,687	+ 24	„	56,613	— 3,419	29	..
Rothesay	„ 13	1,282	+ 29	„	6 880	— 201	2·75	..
Southport	„ 13	1,000	+ 5	„	9,339	— 284	3·17	..
S. Metropolitan	„ 13	2,331	— 109	„	25,291	— 589	..	..
Swansea	„ 13	2,477	+ 22	„	30,642	+ 474	12·5	..
Tynemouth	„ 13	1,801	+ 257	„	7,823	+ 413	3·75	..
Weston-s-Mare	„ 13	1,297	+ 151	„	4,691	+ 216	3	..
‡Worcester	„ 13	869	— 51	„	8,893	— 90	5·75	..
Wrexham	„ 13	250	+ 3	„	3,110	— 143	..	..
Yorks. Wool. Dist.	„ 13	2,051	— 97	„	28,862	— 468	17	..
Miscellaneous	„ 13	607	+ 26	„	6,623	+ 28	..	..
Burnley	Aug. 21	2,725	+ 59	..	..	..	..	..
Burton-on-Trent	„ 22	579	+ 16	21	5,562	— 147	6·63	..
Bury	„ 15	2.694	+ 169	19½	23,768	— 590	22·5	..
Cardiff	„ 14	6,076	+1,010	20	44,966	+ 812	..	..
Carlisle	„ 21	387	— 12	33	5,495	— 224	..	..
Chatham and Dist.	„ 19	2,145	+ 312	33	26,771	+ 1,483	14·98	..
Cork	„ 19	1,139	— 65	33	14,473	— 811	..	..
†Croydon	„ 6	2,050	+ 152	..	28,170	+ 122	11·25	4·75
†Darlington	„ 14	192	— 2	20	3,747	— 230	..	..
Darwen	„ 20	552	+ 5	20	5,167	— 220	4·86	..
†Dover	„ 14	826	+ 18	20	4,318	— 477	4·75	..
Dublin	„ 20	12,534	+1,087	..	43,957	+ 817	54·25	..
Dundee	„ 4	2,489	— 185	11¼	13,852	— 613	15	..
East Ham	„ 21	2,071	+ 232	20½	21,153	+ 2,905	8·48	·68
†Exeter	July 30	340	— 30	18	6,212	+ 514	5·5	..
Glasgow	Aug. 21	34,694	+ 832	..	196,709	— 3,420	90·5	1·5
Hastings	„ 19	3,440	+ 23	..	..	..	..	..
Huddersfield	..	..	..	..	..	..	..	..
Hull	„ 21	5,314	+ 533	20	51,811	+ 1,219	14·5	1·5
Ilkeston	„ 19	307	+ 16	20	2,758	— 202	..	..
†Ipswich	„ 14	555	+ 65	20	8,268	+ 37	10·5	..
Kilmarnock	„ 21	284	+ 7	14	2,193	— 83	4·25	..
†Lan'kshire Trm. Co.	July 22	3,035	+ 113	29	36,202	— 1,697	17·62	1·12
Lancashire United	Aug. 18	3,223	+ 68	33	43,929	— 148	..	..
Leeds	„ 14	15,158	+1,349	20	135,513	+ 1,549	54	6
†Leicester	„ 21	4,497	+ 205	..	..	..	..	..
†Leith	„ 14	1,507	+ 331	13	8,595	+ 934	6	..
Liverpool	„ 14	23,189	+ 565	32	345,546	— 2,766	104	..
‡L.C.C.	„ 7	74,201	— 882	..	672,818	+21,641	121	4·26
London United	„ 21	15,410	— 891	..	202,901	—20,967	..	..
Lowestoft	„ 21	899	— 61	47	8,190	— 1,020	3·5	..
Manchester	„ 21	30,654	— 819	21	313,445	— 8,792	90·5	6
†Newcastle	„ 14	3,814	+ 147	..	76,996	+ 1,373	..	..
†Newport	July 31	672	— 41	18	11,674	— 382	14·5	..
Oldham	Aug. 22	3,787	— 299	21	40,838	— 2,948	23·75	..
†Pontypridd	„ 14	590	— 7	19½	8,258	+ 1,083	5·5	1·75
Portsmouth	..	..	..	..	..	..	..	..
Preston	„ 18	1,726	+ 108	..	..	..	..	..
Rotherham	„ 19	1,196	— 63	20	12,099	— 545	10	·66
Salford	„ 16	9,723	+ 131	19⅝	92,345	— 3,305	..	..
Sheffield	„ 94	10,896	— 185	21½	120,570	— 1,680	97	1·26
Southampton	„ 18	2,578	+ 148	20	22,222	— 540	..	..
Southend-on-Sea	„ 18	1,907	+ 210	20	11,987	+ 1,932	..	..
South Shields	„ 21	1,319	+ 94	..	12,065	+ 33	..	..
Swindon	„ 18	353	+ 15	.	..	..	..	..
Tyneside	„ 18	1,008	+ 103	7	8,391	+ 208	..	..
Wallasey	„ 14	2,356	+ 110	19½	19,681	+ 523	..	·22
Walthamstow	„ 21	1,574	+ 160	20	14,531	+ 152	9	..
West Ham	„ 12	5,154	+ 215	19	46,095	+ 2,695	15	·3
Wolverhampton	„ 18	1,674	— 46	20	16,582	— 876	12·5	..
Baker St.-Waterloo	„ 21	5 145	— 85	7	20.575	+ 865	4·25	..
Cen. London Rly.	„ 21	8,775	—4,284	7	34,955	—14,069	6·22	·55
Char. +, Eus. Hamp.	„ 21	6,660	+ 645	7	25,845	+ 3,335	7.75	..
City & S. Lon. Rly.	„ 22	6,042	+ 283	7	21,463	+ 1,250	7·8	..
Dublin-Lucan Rly.	„ 20	348	+ 13	7	1,214	+ 6	7	..
G.N. and City Rly.	„ 21	2.327	+ 5	7	7,502	— 32	3·5	..
G.N., P'y. & Brmn.	„ 21	8,490	— 70	7	34,535	+ 755	9·25	..
L'pool Overh'd Rly.	„ 22	3 048	+ 72	7	11,985	+ 19	6·3	4·3
Llandudno-Col. Bay	„ 20	1,611	+ 135	38	10,001	+ 1,761	..	..
Mersey Railway	„ 21	3,688	+ 40	7	13,410	+ 509	4·5	..
Metropolitan Rly.	„ 22	29.705	+ 215	33	110,440	+ 1.917	24·5	..
Met. District Rly.	„ 21	16,692	+ 503	7	66,555	+ 5,260	24	..
Anglo-Argentine	„ 19	77,812	+7,621	32	1,224.697	+76,694	..	..
§Auckland	July 16	13,413	+1,508	28	26,514	+13,296	22·3	3·1
Bombay (B.E.T.)	„ 22	4,598	+ 157	28	72,776	+ 4,262	..	..
§Brisbane	„	16.140	+2,114	..	..	..	..	..
§Brit. Columbia Rly.	June	41,365	+8,826	..	..	..	..	..
Calcutta	Aug. 21	6,625	+ 230	..	..	..	..	..
§Cape Electric T. Ld.	June	11,208	..	..	..	..	..	..
§Kalgoorlie, W.A.	July	2,509	..	30	26,138	..	20·5	..
Madras	Aug. 15	1,378	+ 103	32	18,940	+ 278	..	..
§Melbourne	..	..	..	..	..	..	..	..
§Lisbon	..	..	..	..	..	..	..	..
Perth (W.A.)	„ 20	2,646	+ 98	33	46,601	+ 22	28	2·6

* Compared with the corresponding period of 1908. § One week only.
‡ Includes horse, steam and other receipts. ‖ One month.

STOCKS AND SHARES.

Tuesday Afternoon.

Within the next two or three weeks the holiday season will be finished, and "the public" returned to town once more. Business is expected to show signs of awakening vitality in the middle of September, and here and there around the markets are already to be found indications of a little more general interest in stocks and shares than has been the case lately. That people are coming back from their holidays is patent, even in the Stock Exchange, where many of the principal features are sunburnt and tanned.

Home Railway stocks are amongst those to which barely a flicker of public attention is directed. The dealers sorrowfully admit that theirs does not deserve the dignity of being called a market—a word implying trade, activity and business. The man who has an order in a few thousand of stock is regarded as a curiosity, almost an anachronism, and the daily records of movements in Home Railway stocks are, on the whole, a pitiful exhibition of small shrinkages.

Metropolitan Consolidated has gone down with the rest of them, and shows a loss of 15s. Central London Preferred certainly has replaced its loss of 2, thanks to a retail buying order. Other alterations in electrical rails there are none. The Tube Debenture stocks have hardened, and Bakerloo Fours have attained, at last, the level of 100. Charing Cross Debenture improved to 93½, Great Northern and Piccadilly Debenture to 95½. That both will go ultimately to par there seems to be little room for doubt.

Electricity Supply shares are a good second to Home Railway stocks, and, indeed, it may be true to say that the latter themselves are less dormant than the former. Charing Cross Preference and Metropolitan Ordinary eased off a trifle, and Westminsters, of both kinds, are ½ higher. South Metropolitan 4½ per cent. First Debenture stock gained 2. There the story ends, and in this barren recital can be found no such cause for complaint as reached us the other day from a Stock Exchange reader. He declared that it was impossible to pick up the paper without finding a growl at market methods, such as the quotation of prices at unduly large margins, the retention of others at levels which did not fairly represent the market values, and so on. The touching upon such points, however, is surely part of an observer's duty, and if the market were to do more than to command that we should bless, Sempronius must deserve it. To descend:—

The Mexican power group has eased off again, and Mexico Tramways stock is 4 points down, while Mexican Light and Power lost 1. Business in Rio Trams has fallen off a good deal, and the price is lower at 92; the 5 per cent. bonds at 94½ have commanded more interest just lately. Sao Paulos went back a little to 149½. Canadian General Ordinary at 124½, shows a rise of 1½, the Preferred at 119½ being without change. Monterey Light, Heat and Power 5 per cent. Debenture kept at 89½, the disastrous fire in the town making no difference to the price.

Anglo-Argentine Trams retain their strength, and Calcuttas are steady. British Columbia Electric Railway Deferred continues to mount, and Cape Electric Trams created a mild surprise by moving up from 5s. to 7s. 6d. British Electric Traction Ordinary are, in Stock Exchange phraseology, a ha'penny harder, and there is no movement in London United Trams.

Advances have occurred in Amazon Telegraphs and Anglo-Americans, a few Debenture stocks also hardening. The quiet improvement in the fixed-interest stocks is all the more worth noticing, because the movement has been going on quietly for some time past. Marconi's shares have not been affected by the unfortunate accident to one of the company's stations. National Telephone issues are firm, with 5s. rises in the First and Second Preference shares.

Manufacturing shares continue very steady. The British Insulated and Helsby Cables Co. has declared an interim dividend at the rate of 8 per cent. on its Ordinary shares. Cromptons are better, and Armament shares show a tendency to improve. Rubbers are a good market.

American Telephone and Telegraph Co.—The *Financier* states that the earnings of this company for the first seven months of 1909 are as follows:—Gross, $19,315,000; net, after payment of interest, $13,463,000; net, after payment of dividends, $5,832,000. In 1909 all maintenance and depreciation is charged against expenses monthly, instead of being partly provided for by an extraordinary charge in December, as heretofore.

British Insulated and Helsby Cables, Ltd.—The directors announce an interim dividend at the rate of 8 per cent. per annum.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations Aug. 17th.	Closing Quotations Aug. 24th.	Business done week ended Aug. 24th, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2⅜ — 2½	2⅜ — 2½	..	..	+ ⅛	Nil.
136,700	Do. do. 5 % Debs., Nos. 1 to 1,360 Red.	100	5 %	5 %	5 %	5 %	93 — 96	93 — 96	..	..	..	5 4
$181,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7½ %	8 %	8 %	8 %	145 —146	144 —146	145	..	— ½	5 9
$68,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 0
558,460	Anglo-American Telegraph	Stock	24%	8%	5%	£3 4s.	60 — 62	60¼ — 62½	60½	..	+ ½	5 3 0
3,220,770	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	103 —104	103½ —104½	104	103½	+ ½	5 14 10
3,220,770	Do. do. do. Deferred	Stock	1%	1%	1 %	8/-	19⅜ — 19⅞	20⅜ — 21	20⅝	19½	+1⅛	1 18 1
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	103½ —105½	103½ —105½	..	..	..	4 14 9
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	8 — 8⅛	8 — 8⅛	8⅛	..	..	4 14 1
2,431,350	Commercial Cable, Sling. 500 year 4% Deb. Str. Red.	Stock	4 %	4 %	4 %	4 %	90 — 92	90 — 92	90½	..	..	4 7 0
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	8½ — 9	9 — 9	..	..	..	6 13 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 — 18	17 — 18	..	..	..	5 11
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	2⅜ — 2⅝	2⅜ — 2⅝	..	..	..	5 8 8
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..	5 12 6
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	5 16 8
60,710	Direct United States Cable	20	4½%	4½%	4½%	4½%	12⅜ — 12⅝	12⅜ — 12⅝	12⅝	12⅜	..	6 13 7
48,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99⅜ —101½	..	..	..	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	129 —132	129 —132	131	130	+ ½	5 6 1
2,000,000	Do. 5% Pref. Stock..	100	5%	5%	5%	5%	84½ — 86½	84½ — 86½	..	..	..	4 0 0
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	104½ —106½	104½ —106½	106	105	..	3 15 2
800,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	7 %	11⅜ — 11½	11⅜ — 11½	11 1/16	11 7/16	..	5 17 11
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 —104	103 —104	..	..	..	3 16 11
200,000‡	East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	5½%	10½ — 10⅞	10½ — 10⅞	10⅞	10⅝	..	5 7 0
181,127	Do. do. 6 % Pref..	10	6 %	6 %	6 %	6 %	13⅝ — 14	13⅝ — 14⅛	14	13⅞	+ ⅛	4 4 11
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	24%	20 %	20 %	18 %	26½ — 27½	26 — 27	..	..	— ½	6 13 4
10,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99½ —101½	..	..	+ ½	4 8 8
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	18 %	51½ — 53½	51½ — 53½	51½	..	..	6 1 6
$41,880,400	Mackay Companies Common	$100	2 %	3½%	4 %	4 %	80 — 84	80 — 84	..	..	..	4 15 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	74 — 78	74 — 79	..	..	..	5 2
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	¼ — ⅜	¼ — ⅜	15/6	14/3	..	Nil
72,580	Monte Video Telephone Co., Ltd. Ord.	1	5 %	6 %	6 %	6 %	⅜ — ½	⅜ — ½	..	..	..	6 0 7
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	⅜ — ½	⅜ — ½	..	..	..	5 13 3
3,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —107½	106 —107½	107	106½	..	5 11 7
3,725,000	Do. do. Def. Stock	100	5 %	5 %	6 %	6 %	123 —125	123 —125	124	123	..	4 16 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅜	10⅜ — 10⅞	..	..	+ ⅛	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	5 %	6 %	6 %	10 — 10⅜	10⅛ — 10⅜	..	..	+ ⅛	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 7/16 — 5 9/16	5 7/16 — 5 9/16	..	..	..	4 7 8
3,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	..	..	..	3 10 0
1,993,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99½ —101½	100 —102	..	..	+ ½	3 18 5
175,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	7 %	8 %	8 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..	5 6 8
50,000	Do. do. do. 6 % Cum. Pref.. ..	1	6 %	6 %	6 %	6 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..	5 8 0
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	86 — 87	86½ — 87½	86⅝	85⅞	+ ½	4 11 5
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	99½ —101½	99½ —101½	..	..	..	3 18 10
11,888‡	Reuter's	8	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	99½ —101½	100 —102	102½	100½	+ ½	4 8 8
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	130 —132	130 —133	131	..	..	4 10 11
120,000	United River Plate Telephone	5	6 %	6 %	6 %	..	6⅛ — 7⅛	6⅛ — 7⅛	7⅛	6⅜	..	5 11 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 10 8
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	2½%	2½%	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	4 10 11
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99½ —101½	99½ —101½	..	..	..	3 18 10
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980.. ..	10	7 %	7 %	7 %	..	13⅛ — 14	13⅜ — 13⅞	13⅞	13 15/16	— ⅛	5 0 11
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102½ —104½	102½ —104½	103	..	..	3 16 7
88,231	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	5 %	6 %	6 %	6 %	8 — 8½	8 — 8½	..	..	..	7 1 2
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	£2 8	15 %	8 — 9	8 — 9	..	..	..	17 2 4
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000	5	..	..	..	..	.. ..	4 11/16 — 4 13/16	97/6	95/-	..	5 1 3
500,000	Do. 5 % 2nd Pref., 800,001 to 1,500,000	5	..	..	..	..	.. ..	4 7/16 — 4 11/16	..	..	..	5 6 8
978,280	Do. 4 % Deb. Stock	..	..	..	..	4 %	92 — 93	94 — 99	99½	92½	..	4 6 0
382,387	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —104	102 —105	..	..	+ ½	4 15 3
580,000	Babcock & Wilcox, 1 to 580,000	1	20 %	20 %	20 %	20 %	4 5/16 — 4 7/16	4 5/16 — 4 7/16	..	..	..	4 9 11
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	4 0 0
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	33/9	..	..	48 0 0
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	33/9	..	..	18 18 4
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	3⅛ — 3½	3⅛ — 3½	66/10½	..	+ ½	8 0 0
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	2¼ — 3¼	2¼ — 3¼	..	..	..	5 14 3
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	..	5½%	5½%	5½%	93 — 96	95 — 98	..	..	+2	5 12 3
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	8 %	8 %	145 —149	146 —150	..	..	+1	5 6 8
400,000	Do. Pref. Ord. Stock	100	6 %	6 %	6 %	6 %	121 —125	121 —125	123	..	..	4 16 0
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	107 —110	108 —111	109	108½	+1	4 10 1
233,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	103½	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
188,301	British Electric Traction	10	3 %	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	+ 1/16	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	8 %	1½%	2 — 2½	2 — 2½	47/6	..	..	6 0 0
1,478,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	86 — 88	85 — 88	85½	..	..	5 16 3
598,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	63 — 67	63 — 67	..	..	..	6 14 4
100,000	British Insulated and Helsby Cables	5	8 %	10 %	10 %	10 %	7⅜ — 7½	7⅜ — 7½	7⅜	7¼	..	6 9 0
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6⅜ — 6¼	6⅜ — 6¼	6⅜	..	..	4 11 8
500,000	Do. do. 4½ % 1st Mort. Deb. Red..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	101⅛	101	..	4 4 11
304,941	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	91 — 96	91 — 96	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	7/16 — 7/8	7/16 — 7/8	5/8	..	..	Nil
1,916,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	38 — 42	38 — 42	..	..	..	9 10 6
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
60,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,711 ..	5	2½%	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	6 %	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	43 — 48	43 — 48	..	..	..	9 8 8
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	27 — 31	27 — 31	..	..	..	14 10 2
127,610	Calcutta Trams, 1 to 127,610	5	8 %	8 %	6 %	4½%	4 3/16 — 4 5/16	4 3/16 — 4 5/16	98/9	..	..	4 12 2
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,280..	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	5 0 0
260,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	97 —100	97 —100	98½	98½	..	4 10 0
85,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	15 %	10½ — 11	10½ — 11	10 5/16	..	..	6 16 6
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 13 1
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104½ —106½	104½ —106½	..	..	..	4 4 6
491,223	Cape E. Trams., 1 to 491,223	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	+ ⅛	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	6 %	8 %	12 %	12½%	1⅛ — 2 1/16	1⅛ — 2¼	..	..	..	6 0 6
210,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4 %	105 —108	105 —108	105½	..	..	3 14 1
1,890,690	Central London Railway, Ord. Stock..	Stock	4 %	4 %	3 %	3½%	61 — 63	61 — 63	62½	..	..	5 3 2
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	81 — 83	83 — 86	85	..	..	4 16 2
554,655	Do. do. Def. do.	Stock	4 %	4 %	2 %	2½%	43 — 45	43 — 45	..	..	..	5 11 1
1,480,000	City and South London Railway	Stock	17%	3½%	3½%	1½%	31½ — 33½	31½ — 33½	31½	31½	..	4 12 4
85,000	Crompton & Co., Nos. 1 to 85,000	5	3½%	5 %	5 %	5 %	¾ — 1	¾ — 1⅛	17/6	..	+ ⅛	13 6 8
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	9 — 93	90 — 93	..	..	..	5 7 6

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1906.	1907.	1908.	Closing Quotations Aug. 17th.	Closing Quotations Aug. 24th.	Business done week ended Aug. 24th. 1909. Highest	Lowest.	Rise + or Fall −	Present Yield per cent.
		*										£ s. d.
300,000	Dick, Kerr & Co., 1 to 300,000	1	10 %	10 %	10 %	10 %	1¼ — 1½	1¼ — 1½	23/6	..	..	8 0 0
305,000	Do. do. 5 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1⅝ — 1¾	1⅝ — 1¾	..	..	..	4 16 0
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12⅞ — 13⅜	12⅞ — 13⅜	..	..	..	4 7 8
99,361	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,361	5	4½%	4½%	2½%	1½%	⅞ — 1	⅞ — 1	..	..	..	20 0 0
17,189	Do. "A" shares, 01—017,189	5	4½%	4½%	2½%	2½%	1 — 1⅛	1 — 1⅛	..	..	..	8 6 8
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	68 — 73	68 — 73	..	..	..	5 9 7
67,730	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	84 — 87	84 — 87	..	..	..	5 12 4
112,100	Electric Construction, 1 to 112,100	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
81,360	Do. do. 7 % Cum. Pref., 1 to 81,360	1	7 %	7 %	7 %	7 %	1⅛ — 1¼	1⅛ — 1¼	..	..	..	9 18 1
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7⅞ — 8	7⅞ — 8⅛	..	..	+ ⅛	6 1 3
100,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	85 — 88	86 — 88	..	..	..	4 10 11
75,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 75,000	10	4 %	4 %	1½	Nil	¾ — 1	¾ — 1	..	..	..	5 13 4
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ — 10⅞	10½ — 10⅞	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103½	..	..	..	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15%	15 %	15%	15 %	12⅝ — 13⅛	12 — 13⅛	13	..	+ 1/16	5 12 2
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	5 7/16	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105⅜ -107½	105⅜ -107½	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works..	10	10%	10 %	10 %	10 %	14⅜ — 15⅜	14⅜ — 15⅜	15 7/16	14⅜	..	6 13 4
37,500	Liverpool Overhead Railway, Ord. †	10	Nil	Nil	½%	Nil	⅝ — ¾	⅝ — ¾	..	..	..	Nil
10,000	Do. do. Pref., fully paid †	10	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..	10 0 0
600,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	3 %	Nil	1½ — 2⅛	1½ — 2⅛	..	..	..	Nil
899,980	Do. do. 50,008 to 100,000	10	3 %	3 %	3 %	Nil	1½ — 2⅛	1½ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	32½%	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	15 8 4
1,381,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	..	4 %	68 — 71	68 — 71	68	..	..	5 12 8
5,782,062	Metropolitan Consolidated	100	28%	1 %	½%	½%	40 — 40⅝	39½ — 39⅞	39⅝	39½	— ⅛	1 5 3
2,640,914	Do. Surplus Lands	100	28%	28%	2½%	2½%	65 — 67	65 — 67	66½	66½	..	4 2 1
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	17 — 17⅛	17 — 17⅛	17⅛	17	..	Nil
291,337	Metropolitan Electric Trams., Ord.	1	..	..	..	4½%	⅛ — ⅜	⅛ — ⅜	..	..	..	..
314,016	Do. do. Defd.	1	Nil	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ — ⅜	⅛ — ⅜ xd	..	..	..	6 3 1
595,500	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..	4 12 9
10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	..	128 —131	124 —127	128⅜	123⅜	- 2	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	..	5 %	96 — 98	95½ — 97½	97½	96½	— ½	5 2 7
245,500	Potteries Electric Traction	1	4 %	4 %	4 %	Nil	⅜ — ½	⅜ — ½	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1½ — 2	1½ — 2	12/-	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	86 — 89	86 — 89	..	..	..	5 1 2
87,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	15 %	34 — 36½	34½ — 36	35½	34½	..	2 10 9
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —101½	100 — 102	..	..	+ ½	3 18 5
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	5 %	102½—103½	103 —104	103⅝	103½	+ ½	4 16 2
2,800,000	Do. do. 4½% Bonds	..	..	..	..	4½%	88 — 90	88 — 90	..	..	..	5 1 2
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	35 — 37	36 — 38	38½	36⅜	+1	..
66,666	Willans & Robinson, 1 to 30,000 & 30,001 to 116,666	5	Nil	Nil	10 %	Nil	⅜ — ½	⅜ — ½	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 30,000 & 126,001 to 141,666	1	Nil	..	6 %	6 %	2⅜ — 2¾	2⅜ — 3⅛	53/9	..	..	1 18 5
215,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000		5½%	5½%	5½%	5½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10%	10 %	10 %	7⅞ — 8 xd	7⅞ — 8	..	..	..	6 5 0
9,151	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7¾ — 8 xd	7⅞ — 8	..	..	..	4 7 6
886,76	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	3 18 5
80 00	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	4 — 4½	4 — 4½	..	..	..	5 11 1
80 00	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4½ — 5	4⅝ — 4⅞	90/7½	..	— ⅛	4 12 4
80 00	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..	5 2 10
446. 36	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	97	..	..	3 19 3
49. 36	Chelsea Electricity Supply, Ord.	5	6 %	4½%	4½%	4½%	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..	5 9 1
175, 00	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —108	100 —108	..	..	..	4 7 5
70,585	City of London Elec. Lighting, Ord. 40,001—110,586	10	6 %	6 %	6 %	6 %	10⅜ — 10⅞	10⅜ — 10⅞	10⅜	10⅜	..	5 9 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ — 11⅝	11⅜ — 12⅛	..	..	..	4 12 4
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 8
50,000	County of Durham Electrical Power, Ord.	5	4 %	4 %	2 %	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..	3 6 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	3 — 3⅛	3 — 3⅛	..	..	..	7 2 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	5 %	93½ — 95½	93½ — 95½	..	..	..	5 4 9
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅜ — 8⅛	7⅜ — 8⅛	..	..	..	6 1 3
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11	10½ — 11	10⅞	10⅜	..	5 9 1
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Edmundson's Electric Corporation, Ord. Shares	5	4 %	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	3 %	Nil	Nil	⅛ — ¼	⅛ — ¼	12/6	..	..	Nil
400,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	58 — 61	58 — 61	..	..	..	7 7 7
$8,150,000	Electrical Dev.Co.of Ontario, 5% 1stMtg.Gold Bnds.	$500	..	..	..	5 %	84½ — 86½	86 — 88	..	..	+1½	5 13 8
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 7 4
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 — 5¼	5 — 5¼	..	..	..	4 10 0
95,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	9 %	9 %	8½%	8½%	7⅜ — 7⅝	7⅜ — 7⅝	..	..	..	5 11 6
$1,375,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	5 %	98 —101	98 —101	93¾	..	..	4 19 0
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	10 %	8 %	6⅜ — 6⅞	6⅜ — 6⅞	..	..	..	5 16 4
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	5	4 %	4 %	2½%	3 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..	4 16 0
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	5 11 8
£82,855	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4½%	4½%	4 %	93 — 97	93 — 97	..	..	..	4 2 6
800,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	8 %	6½%	5 %	4⅛ — 4⅜	4⅛ — 4⅜	85/7½	85/-	— ⅛	5 7 6
75,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅝ — 5	4⅝ — 5	..	..	..	4 10 0
235,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
248,000	Do. 5% Mort. Deben. Stock Redeem.	Stock	5½%	5½%	5½%	5½%	83½ — 86½	83½ — 86½	..	..	..	4 0 11
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	5 %	83½ — 84½	83½ — 84½	84½	83⅜	..	5 17 8
$15,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	5½%	72 — 76	71 — 75	74⅛	72⅛	—1	4 13 4
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	7 %	106 —110	106 —110	108½	108	..	6 7 8
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	5 %	86 — 88	86 — 88	87½	87	..	5 18 8
460,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
180,491	Newcastle-on-Tyne, 1 to 187,500	5	5 %	5 %	5 %	2½%	4 — 4½	4 — 4½	..	..	..	2 15 7
187,500	Do. 5 % Pref., 1 to 187,500	5	5 %	5 %	5 %	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	6 0 0
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	..	99 —101	99 — 101	..	..	..	..
10,853	Notting Hill Electric Lighting	10	7½%	7½%	7½%	7 %	11 — 12	11 — 12	..	..	..	5 16 8
20,000	Oxford, 1 to 96 and 407 to 20,319	5	7 %	7 %	7 %	..	6 — 6⅛	6 — 6⅛	..	..	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	2½%	6 %	8 %	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..	5 7 3
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1⅜ — 1⅝	1⅜ — 1⅝	20/6	..	..	5 10 4
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	5 8 1
40,000	St. James' and Pall Mall Electric Light, Ord.	5	12½%	10 %	10 %	10 %	8¾ — 9	8¾ — 9	..	..	..	7 2 10
70,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	7 — 7¼	7 — 7¼	..	..	..	4 11 10
150,000	Do. do. 5½ % Deb. Stock Red.	100	5 %	5½%	5½%	5½%	84 — 88	84 — 88	..	..	..	6 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	Nil	Nil	Nil	⅝ — ¾	⅝ — ¾	..	..	..	Nil
85,000	South London Electric Supply, Ord.	4	4 %	3 %	4 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 13 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	2½%	⅞ — 1	⅞ — 1	..	..	..	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..	5 6 8
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100—104	102 —105	..	..	+1½	4 5 9
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	½ — 1	½ — 1	..	..	..	25 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1½ — 2	1½ — 2	..	..	..	12 10 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	77 — 81	77 — 81	..	..	..	5 11 1
800,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	5 %	⅝ — ¾	⅝ — ¾	..	..	..	5 6 8
110,000	Westminster Electric Supply, Ord.	5	13 %	12 %	10 %	10 %	8½ — 9	8½ — 9½	..	..	+ ⅛	5 9 9
81,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	5 %	4½%	4½%	4½%	4½ — 5½	5 — 5½	..	..	+ ⅛	4 3 0

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. Interim Dividend.

Bank rate of Discount 2½ per cent., April 1st, 1909.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JULY, 1909.

ALTHOUGH the returns for export business during July reached an extraordinarily high value, it will be seen that this was due entirely to the spasmodic rise in telegraphic exports, which attained to something like 10 times their normal value.

Actually the exports amounted in value to £501,749, as compared with £270,268 in June, but this half million total included £255,093 worth of telegraphic material—one item of £184,011 going to the States—and exclusive of this, £246,663 worth of general business remains (which is comparable with previous years' returns). This latter total is somewhat less than in the June return.

The imports have been steadily improving during the past three months, and the July total of £161,190, compares with £158,119 in the previous month. The re-exports, at £12,577, were approximately £500 better than in June.

Naturally the telegraphic section of the exports is the most bulky in the return; electrical machinery exports of all kinds were practically as good as in June, and the telephonic exports were some £12,000 better than in that month. Machinery and carbon imports show a large increase, but the value of telephonic and telegraphic material coming in was much less than in June; lamp imports remained steady. The United States, Japan, Brazil, Canada, and India were prominent purchasers, while among the increasing number of importers which find a place in the returns, Germany, as usual, heads the list with £92,708.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric lamps and parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	153	79	78	...	54	4,063	80	...	...	28	349	4,884
Germany	93	154	63	...	222	1,022	...	13	...	20	550	2,137
Netherlands	348	1,094	7	15	31	526	...	11	...	5	41	2,078
Belgium	885	459	74	80	277	1,537	5	34	...	262	26	3,639
France and French West Africa and India ...	199	20	237	374	8	2,070	...	...	...	60	355	3,333
Portugal	99	...	24	...	13	71	4	4	...	...	47	262
Spain and Canary Isles...	171	...	22	104	...	296	20	12	27	15	479	1,146
Italy, Switzerland and Austria-Hungary ...	114	86	20	51	755	1,441	...	5	...	...	282	2,754
Greece and Turkey	57	...	22	...	8	431	...	54	...	11	134	717
Channel Isles, Gibraltar, Cyprus and Malta ...	69	81	6	51	21	623	...	12	...	...	14,456	15,319
U.S.A., Philippines and Cuba	323	...	80	118	30	18,717	...	...	18	...	184,011	203,297
Canada and Newfoundland	29	890	836	696	287	3,074	3	323	...	3,753	22,247	32,404
British West Indies and British Guiana ...	111	...	45	41	...	16	...	...	...	52	24	289
Mexico, Colombia, Panama, Venezuela and Ecuador	116	742	...	100	25	50	...	...	...	5	1,771	2,809
Peru and Uruguay	132	1,685	172	179	...	294	...	3	...	76	237	2,778
Chile	...	128	266	251	96	1,345	...	144	108	281	69	2,688
Brazil	249	5,157	330	367	352	9,904	865	371	10	1,997	23,147	42,749
Argentine	1,163	865	42	730	472	2,660	5,801	574	55	1,625	645	14,532
Egypt	91	59	1	117	...	145	2	126	...	348	246	1,135
British West Africa and St. Helena	8	633	...	106	2	3,075	...	...	...	332	10	4,166
Azores, Madeira, Port. East and West Africa	134	376	91	32	37	646	...	...	...	15	115	1,446
Cape of Good Hope	652	1,065	52	115	186	1,251	...	414	...	4	68	3,807
Natal	592	3,271	130	316	314	4,361	...	116	...	89	81	9,270
Zanzibar, Brit. East Africa, Mauritius and Aden	26	236	2	133	27	293	...	10	12	109	456	1,304
Rhodesia, Orange River Colony and Transvaal	1,039	1,094	33	468	18	1,036	...	93	229	1,589	53	5,652
China and Siam	261	2,160	114	84	40	1,417	682	172	...	9	3,059	7,998
Japan	488	11,950	1,025	...	355	14,495	9,469	...	...	11,304	686	49,772
Java and Dutch Borneo...	45	...	28	...	...	...	...	3	...	...	...	76
India	1,572	6,578	866	1,524	654	7,111	4,239	3,394	450	167	758	27,313
Ceylon	15	157	74	131	...	502	...	84	...	...	20	983
Straits Settlements and Fed. Malay States ...	217	1,286	281	143	186	529	110	108	...	115	111	3,386
Hong Kong	260	230	164	212	379	847	1,600	13	34	11	21	3,771
West Australia	1,641	585	41	59	200	671	40	572	...	200	18	4,027
South Australia	134	79	...	91	...	2,616	...	56	...	1,571	...	4,547
Victoria	727	3,256	175	256	145	3,590	...	251	..	5,464	125	13,969
New South Wales	976	238	532	1,355	375	2,124	2,574	766	...	1,189	32	10,161
Queensland	402	21	28	85	...	197	...	42	...	...	...	775
Tasmania	15	9	...	...	...	744	...	...	...	946	...	1,714
New Zealand	582	2,440	457	197	148	2,724	300	485	...	952	367	8,652
Total, £	14,354	47,163	6,418	8,581	5,717	96,814	25,794	8,265	943	32,604	255,096	501,749

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Norway, Sweden and Denmark	...	...	...	97	...	394	34	358	42	2,233	3,158
Germany	615	9,490	1,368	30,388	2,767	28,615	286	597	6,482	12,100	92,708
Holland	...	40	...	2,610	...	198	2,636	...	91	29	5,604
Belgium	154	11,318	312	10	37	3,238	...	125	422	8,032	23,648
France	...	70	1,031	1,425	680	278	3	994	2,618	333	7,432
Switzerland	17	58	...	...	37	314	...	...	14	107	547
Austria-Hungary...	...	588	12	720	30	342	...	41	1,609	36	3,378
Italy	54	2,954	...	12	24	...	68	...	...	186	3,298
United States	1,150	10	1,017	1,213	145	8,798	8,250	438	80	132	21,238
Total, £	1,990	24,528	3,740	36,480	3,720	42,177	11,277	2,553	11,358	23,188	161,011

Additional imports: Spain, lamps, £100; carbons, £27. Portuguese East Africa, goods, £15. Victoria, electrical machinery, £37.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	
Various countries, mainly as above	2,039	230	...	2,688	...	3,183	...	298	663	3,476	...

TOTAL EXPORTS: £501,749. TOTAL RE-EXPORTS: £12,577. TOTAL IMPORTS: £161,190.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

THE ELECTRICAL INSTALLATION AT THE NEW VICTORIA AND ALBERT MUSEUM.

In June of this year, just 50 years after the opening of the old museum, the new buildings of the South Kensington Museum, the largest collection of applied arts in the world, were declared open by their Majesties, the King and Queen, with due State ceremony.

The general scheme of the electrical installation at the Museum was designed by the Engineering Division of H.M. Office of Works, to meet the requirements of the architect and the Board of Education, as represented by the museum authorities some three or four years ago. The original scheme has been modified from time to time during the progress of the work, to meet the views of the Committee of Arrangement and the newly appointed Director of Art, including also such changes as were necessitated by structural alterations, and those required for the adoption of metallic-filament lamps when these became available.

The supply of current for the building is taken from the Kensington and Knightsbridge Electric Lighting Co., Ltd., on the three-wire continuous-current system, at 200 and 400 volts. The three cables are brought into the building at two separate meter rooms, some 180 yd. apart. In each of these rooms the supply is then divided to feed a power switchboard at 400 volts and two lighting switchboards at 200 volts, one in each room on the positive and one on the negative side of the three-wire system. The power boards have a main panel and three or four circuit panels respectively, the current being metered before arriving at the switchboard. The four lighting boards have each one main and six circuit panels, the latter being, for the sake of uniformity, all of 200 amperes capacity. In this case (to meet the wishes of the supply company who considered the large size meters, which would otherwise have been necessary, undesirable) the current has been metered at each circuit panel and not before reaching the main bus-bars. On entering the switch room the cables are divided, the neutrals being laid in a trench in the wood block floor and the live poles carried overhead on a shelf. Each circuit panel consists of two distinct slabs carrying D.P. knife switches, tandem-coupled, and fuses of the hand-grip type. The panels are of white Sicilian marble 1¾ in. thick, mounted on an angle-iron frame; they were made and erected by the Westminster Engineering Co., Ltd. The instruments, recording and other, are of Nalder Bros.' manufacture.

From the circuit panels of the lighting boards paper-insulated, lead-covered cables, made by W. T. Glover & Co., Ltd., of which there are in all some 3 miles, the largest size used being 91/13, run to main fuseboards at various points on the lower ground floor, such boards having usually four D.P. ways controlled by hand-grip fuses. These ways feed, through lead-covered rising mains, the distribution boards on each of the four floors in that section of the building, from which the lights themselves are switched on and off. The distribution boards have 10-ampere ways throughout with D.P. fuses, the stoneware holders of which have bridge threadings, and S.P. Diamond-type, quick-break switches mounted on white marble panels. All the circuits have the lights they control indicated on a white label fixed above the switch.

The sizes of mains and circuit wires have been calculated so that the fall of potential between the meter rooms and the most remote circuit (say, 700 ft. run) when full load is passing, does not exceed 1·5 per cent. The mains from the power boards run direct to the D.P. switches of the motors.

The power installation consists of four 45-H.P. motors, and four electric lifts, on the 400-volt supply. There are also 14 30-in. ventilating fans, and one small pump in the boiler house, which are driven from the 200-volt mains. The 45-H.P. motors, only two of which are in use at any one time, are for driving, by belt, the large fans of the Plenum ventilating and heating system. They were made by Messrs. Newtons, Ltd., of Taunton.

Of the lifts, two for 1,500 lb. are for the use of the general public; it is believed that this is the first time such a convenience has been provided in any public museum. These, with a smaller lift for office use, were installed by the General Electric Co. The fourth lift is also for office use, but is provided with push-button control, instead of requiring an attendant to operate it from the cage, as do the others. This lift has been made and erected by Messrs. R. Waygood and Co., Ltd. All the lifts have both electrical and mechanical locking gear on the doors. The total travel of each public passenger lift is 83 ft., at a speed of 180 ft. per minute.

The contractors for the general installation were Messrs. T. Clarke & Co., of 129, Sloane Street, under the supervision of H.M. Office of Works. The wiring throughout is 2,500-megohm grade, and is drawn into galvanised, heavy gauge, screwed conduit. It is interesting to note that the test of the whole of the wiring before the erection of fittings, both poles to earth, was 1·7 megohms in No. 1 switch room, and 1·6 megohms in No. 2 switch room. There are in all about 1,700 points.

The tubing throughout the public galleries is chased into the floors and walls, traps being arranged in the wood-block flooring, and, occasionally, in the fibrous plaster cornices, to give access to the draw-in boxes.

In addition to the general lighting of the galleries, a special pilot light circuit has been arranged, fed directly from the main bus-bars, for the use of the night police or in case of emergency. These lights are controlled by local switches instead of from the distribution boards. As there is usually only one such light for each gallery or flight of stairs, it will be readily understood that very long and expensive runs were entailed by this circuit. Those pilot lights which are adjacent to fire alarms are provided with ruby shades.

As a general rule it may be said that the architectural courts and the textile galleries are lighted by arc lamps and the wood-work, ceramic and engraving sections by metallic-filament incandescents.

The arc lamps are all of the enclosed type, burning two in series on the 200-volt circuit. There are approximately 140 8-ampere and 200 3-ampere lamps in use, the order for these being divided between the Westminster Engineering Co. and the Maxim Electrical Co. The majority of the 8-ampere lamps are provided with counterweights, of a simple pattern, for convenience in trimming, and the lamps which come near the bridges and balconies have oblique metal reflectors to shade the light from the eyes of the people on the first floor. The counterweights are suspended from the iron terminal-boxes by six-core insulated flexible cable: each core consists of nine strands of copper and three of steel wire wound on a centre of string, and the whole six are twisted round a seventh core of string. The insulation is cotton, pure rubber and braid. The flexibles pass round boxwood pulleys and are attached to a special cross-arm on the top of the lamp resistance. It should be said that in the case of both the large and the small lamps, the line resistance forms the top part of the lamp. The terminal boxes are filled in with paraffin wax to prevent moisture accumulating in them from the steel work of the roof.

Owing to the way in which the old and the new buildings are sandwiched together, the difference in lighting is very noticeable in many adjacent galleries; particularly so in passing from the Octagon Court, in which at present various loan collections are on exhibition, into Gallery 41, formerly the Science Library. The latter is still lighted by means of 10-ampere Siemens "Differential" open-type arcs, four in series on 200 volts, which have been in use since 1883. Much of the wiring in the old Museum is surface work on the "tree" system, the building having been a pioneer in electric lighting, as some of the galleries were so lighted as long ago as 1878. The re-wiring and better lighting of this part is now being taken in hand, but it will naturally occupy a considerable time.

A very objectionable feature presents itself in many galleries, and especially in the large textile courts, due to the reflection of the lights in the huge sheets of glass with which the exhibits are protected. The Holy carpet in the West Central Court presents a particularly flagrant example of this, either when viewed from a distance of a few feet or with the full 30 yards of the Court intervening. This unfortunate effect is, however, not confined to the hours of artificial light, for throughout the day the white columns and floors behind the spectator are equally troublesome.

The greater part of the incandescent lighting is as follows; a double row of six-light fittings in the 30-ft.

galleries, or a single row of one-light high C.P. pendants in the narrower rooms and passages.

The six-light fittings, of which there are upwards of 270, consist of a flat bronze ring suspended by chains from an inverted bowl containing the mechanical connections, the hook being screwed by means of a stirrup-piece on to the conduit, which, therefore, carries all the weight. The six lamps are each 28-watt, 100-volt, spherical, obscured, metallic-filament lamps under a 6-in. "saucer" opal shade. The lamps directly opposite to one another on the ring are wired in series. The rings hang at a height of 9 ft. from the floor, this having been found to be the best height for lighting the majority of the centre cases. The single-light flexible pendants are also screwed to the conduit, and have similar porcelain mechanical connectors covered by a bronze bowl. The lamps used in these pendants and also in most of the one-light brackets are 100-C.P. or 50-C.P. 200-volt Osrams, under 10 in. × 3 in. conical opal shades. The bronze fittings were supplied by the General Electric Co., Ltd., with the exception of the eight special ceiling fittings on the main staircases, fitted at present with 200-C.P. obscured Osram lamps, which were made by Messrs. G. Forrest & Son.

Only two of the galleries have as yet been fitted with the new gun-metal wall cases, but plug circuits with flush wall plugs about every 6 ft., and 8 ft. 6 in. from the floor, have been run for about 2,000 lineal feet of these. Each plug supplies two reflectors, wired in series, with 28-watt metal-filament lamps for supplying top lighting for the cases. Internal lighting of cases is avoided, as the cases may only be unlocked in the presence of one of the keepers of the particular department, which arrangement would render the lamps and wiring not readily accessible.

In one corridor on the first floor, in which textile exhibits in high cases are arranged down the centre, it has been found necessary to use two-light electroliers, having a spread of about 4 ft., so that the sides of the cases may not be thrown into shadow by the lights hanging immediately above them.

In the case of various large exhibits, as, for instance, the Santa Chiara Chapel in the Eastern Architectural Hall and the Sizergh and other panelled rooms in the Woodwork Section on the ground and lower ground floors, special lighting has been provided. This work, together with the erection of all the fittings and arc lamps, was also carried out by the wiring contractors, Messrs. T. Clarke & Co., under the direction of H.M. Office of Works.

There are, in addition, some 300 plain pendants and other fittings for the lighting of the boiler house, the new offices, stores, hot-air ducts, &c., bringing the total number of incandescent lamps in the new installation up to nearly 3,000 of sizes varying from 8 to 200 C.P.

A fire-alarm installation of 22 points has been installed, and, as the number of positions in the old museum was found to be inadequate, the extension of this is being undertaken at the same time, the number to be increased from six to over 30. Temporary instruments with "Pull" contacts and telephones have at present been fixed to ring simultaneously in the Fire-picket Room and the Police Room, from which a call for the Metropolitan Fire Brigade can be given if needful. This work, together with the extension of the night watchman's tell-tale clock installation, has been carried out by the Engineering Division of the Post Office. The bells required for the new offices have been fixed by Messrs. Comyn, Ching & Co.

NOTES ON TRADE ABROAD.

(*Continued from page* 288.)

How to deal with the French Northern Market.

An American Consul in France in calling attention to the excellent field offered by the French department of the North, hammers away at an old, but often disregarded, suggestion. American goods, he says, cannot be sold by catalogues and correspondence alone. "Neither catalogues nor correspondence should be sent to foreign business houses if not in the language of the country, as merchants are loath to buy goods the exact merits of which they do not know, and are often not able to make out when measurements, prices, &c., are given in the English language." The advice here given has been disregarded in the French market by Americans, and our own manufacturers have been told the story again and again from other parts of the world. We also know that French and German manufacturers are not at all over-anxious on the point, for we receive here, in the course of the year, a good many catalogues written from start to finish in a foreign language. If this American Consul be correct, we, as Englishmen, have some reason to plume our feathers as we contemplate our position in the North of France, for he tells his fellow-countrymen wherein we give them points :—

"In manufactured goods in general the market seems to be monopolised by England and Germany. This is wholly due to the systematic efforts of the manufacturers of those countries who have agents here who perfectly understand the language and the system in which the people are accustomed to do business; who carry samples of the goods they sell, and are prepared to give prompt information in regard to prices and terms of payment. Should the American manufacturer wish to have his share in the business, he must adopt the same measures as his foreign competitors."

Coming from the general to the particular, we find this Consul advising Americans to devote great attention to the coming electrical requirements in and around Roubaix, where large central stations have been installed, and are now supplying mills, industrial establishments, cafés, private houses and workshop installations. The sale of small electric fans for offices, cafés, and large stores would be greatly increased there if the price were not so high. Then after making an interesting circuit of many other lines of manufactures the reporter returns to his first point, and hammers home the warning that "circulars, printed matter and correspondence in English, will be time and labour lost. Have all printed matter in French, giving prices and stating the measurements in the metric system." He adds: "In sending circulars, &c., write to the firm in their language, explaining fully the article for sale, and quote, if possible, prices delivered in their city. Probably a trial order will result, and with this as a reference other firms should be written to or visited if possible." Tariff alterations notwithstanding, British electrical firms looking for an extension of business connections in Northern France should digest the foregoing advice, and see if they are among the careful ones whose example the American Consul holds up for emulation. If they are not—*verb. sap.*

f.o.b. or c.i.f.?

Though indisposed generally to accept the charges hurled at the heads of British firms employing methods which were out of date compared with those of younger commercial competitors, the editor of the *Chamber of Commerce Journal* confesses in his June issue that instances are occasionally brought under his notice which would almost seem to justify the severe and sweeping criticisms referred to, unless it be remembered that it is unsafe to deduce general conclusions from what may be merely isolated instances :—

For example, a correspondent abroad informs us that he recently asked a number of leading British firms in their particular trade for catalogues and prices of a certain article. In reply, one firm wrote that they could not quote a price f.o.b. the foreign port. Apparently the term "f.o.b. the foreign port" was a clerical error for "f.o.b. London." Anyhow, such clerical errors ought not to occur when corresponding with customers thousands of miles away. Again, what possible reason can there be to prevent a firm from quoting a c.i.f. price, if required? At all events, such a firm would be at a very serious disadvantage abroad compared with one which is ready to do so. Another firm was even less explicit, and merely quoted for "delivery at this address," which was a street in the outskirts of a large city. It is obvious that such a quotation is absolutely useless to a foreign customer who cannot have any idea of the cost of transport from factory to steamer. What possible chance can such a firm have in competition with a more up-to-date house which quotes c.i.f. terms, or f.o.b. the export steamer? Yet a third firm forwarded a catalogue of different goods altogether from those asked for. Further, all firms stated that the packing would be extra, but not one of them vouchsafed the least idea of what such charges would be. As we have said before, we hope and believe that methods, or lack of methods, such as those to which we have alluded are the exception rather than the rule amongst British firms. Still, it cannot be too strongly impressed upon firms seeking export trade that they should in all cases give a probable buyer, in the first instance, the fullest information to enable him to arrive at the exact price he will have to pay for the goods, in order to avoid

vexatious and unnecessary delays, which may even result in the loss of the business.

The importance of this point has lately been impressed upon us very strongly by an electrical friend from China now on a visit to this country. He says that when houses in China write home to England for quotations for machinery and electrical manufactures, it is absolutely useless for our firms to post or wire back prices that are not c.i.f. Obviously it is far more difficult for the man in China to ascertain the charges than for the home firms, who possess the necessary particulars of the goods, are accustomed to export shipping, and are in touch with the shipping company. An inclusive price for the whole of an inquiry enables the recipient of the tender to know exactly where he stands in regard to the matter—whether he be ready to order straightaway on the receipt of price, or whether he have to tender again to his own client. We know it is said that it is sometimes impossible for the Britisher to quote c.i.f., because of the inability or indisposition of shipping authorities to co-operate, and he has to give way to the American and German who manages to do so. All we can say is that wherever it is not absolutely impossible, the c.i.f. quotation should be given. The trouble will be well repaid. The same weakness was also alluded to in Mr. Grigg's celebrated Canadian report, referred to later in these notes. He showed how the scale had often been turned against British goods, and in favour of the German, in Canada by negligence of this matter. Strange that our manufacturers should occasion such a frequent source of irritation and annoyance as Mr. Grigg showed it to be.

Catalogue Preparation.

The manufacturer is often guilty of paying too little attention to the convenience of the purchaser when preparing his lists and catalogues. It is in all conscience short-sighted policy to spoil the ship for a ha'porth of tar. Many lists are beautifully got up and handsomely illustrated, but either through some oversight or short-sightedness or an unwillingness to take a little more trouble or spend just a few extra pounds, the entire efforts of an export or publicity department may be defeated. The technical man must learn to stoop from his high estate in his endeavours to meet the wants of a man who is "only commercial" and to a very large extent non-technical. In considering this point in relation to the Eastern Market, the *American Machinist* a couple of months ago wrote editorally as follows :—

> Suggestions have been made that trade lists or catalogues of many every-day mechanical appliances would be no worse if drawn up with more regard to the convenience of non-technical commercial men. Especially for the Eastern market, merchants have often to indent for workshop supplies, the details of which are, in the nature of things, unfamiliar. The Sheffield file list might be mentioned. Quite a number of different styles of files are similarly priced, the variations in cost being governed by their length; but, although prices are named for lengths from 1 in. to 24 in., no indication is given as to the most generally suitable length of, say, round, square or three-sided files in proportion to their diameter, or width across flats. The Sheffield file list and the standard tube lists have been so long and widely accepted that it is, perhaps, too much to hope that the basis prices should be written down so that they should much more nearly represent actual prices. Then rope for use in pulley blocks, scaffolding, &c., will sometimes be sized by girth, sometimes by diameter, and, whilst requisitions will naturally call for given lengths, the catalogues will name prices by the pound. To get at the approximate length per pound will entail a hunt through engineers' handbooks not always at the elbow of general merchants. Again, the wide discrepancies in the price of different types of self-sustaining lifting blocks are sufficient to puzzle a non-technical inquirer, but, if the mechanical efficiency of each type of block were given, the reason for the variation would be apparent. Illustrations of bevel or angular milling cutters are sometimes given, together with the information that they are supplied either right or left hand, but no definition of right or left hand is given, nor how the angle is measured. Ordinary self-interest would lead to the purchaser's task being made as easy as possible.

Australia.

Firms interested in the electrical requirements of Australasia will naturally desire to be placed in possession of information regarding work that has already been accomplished there. During the past few months we have published in the ELECTRICAL REVIEW descriptions of a number of electricity works and the only electrical manufactory of any importance, from the pen of Mr. J. H. Davies. Other plants at Kalgoorlie, Perth, and in other parts of the Continent, have also been described in earlier issues. The last tables of Australian electrical works, with their engineers and voltages, compiled by the *Australasian Hardware and Machinery*, was reprinted in our issue of November 3rd, 1905. In addition, the usual brief particulars of systems of supply, voltages and so forth, are given in the *Universal Electrical Directory* in the Colonial and general classified section, under the heading "Electricity Works."

We have now before us the largest piece of purely electrical publication work that has ever appeared either in, or in regard to, Australia. It is entitled "Electrical Progress in Australia," and was issued as a special number of the *Australian Mining Standard and Electrical Record*. The object of the editor has been to post up all concerned in the progress of applied electricity in Australia, and on the merits of the Australasian market for electrical supply, and to enlist the close attention of engineering firms in the van of progress. As it is always very useful to know what men at the hub of things think of the position and prospects, let us quote the opening remarks of our contemporary's introductory review :—

"Electricity is in favour throughout Australasia for practically all the purposes to which it can be applied. That vast field for electrical enterprise is, therefore, open for exploitation in every direction. It is of vast proportions, and there is any amount of room for the development of all kinds of projects. Suggestions for its introduction are already listened to. In scores of cases where installations have been set up, year after year plants are increased and services augmented. Probably in no part of the world occupied by under 6,000,000 people, do better prospects present themselves for electrical enterprise. An ordinarily careful survey of what has been done, is being done, and will probably soon require to be done, with electricity in Australasia, convinces the critic that this is the case, whilst the strength of his conclusion is reinforced by remembering that the temperament of the Australasian peoples is to be up-to-date, at any reasonable outlay."

Our contemporary then proceeds to give illustrated articles on all kinds of electrical installations that are working in Australia, New Zealand and Tasmania for lighting, power, traction, coal, lead and silver mining work, also hydro-electric systems. Photographs also appear of a number of leading men—some of them old familiar friends—in the Electrical Association of New South Wales and the Electrical Association of Victoria.

Other literature that has lately reached our hands concerning this part of the world includes a "Handbook of South Australia; Progress and Resources," by David J. Gordon, issued by the Government of South Australia. The chief object in view in publishing the volume is to guide immigrants, tourists and settlers, and that being so it must necessarily contain also an account of the leading industries. These are particularised in this book with notes on their growth, information being also given of the resources of the State, with the idea of indicating the scope for industrial expansion. For the worker there are notes on the cost of living and the wages paid for skilled and unskilled labour. Manufactories exist there for various non-electrical purposes, and in this connection we observe it stated that "a winding engine for mining purposes, recently manufactured by a South Australian engineering firm for Broken Hill, is credited with having a world's record for hauling power. Under Legislation of the year 1907, boards were created in respect to certain trades for the regulation of wages, and the principle of the eight-hours system is in general operation throughout South Australia. For the past 40 years there has been in existence a South Australian Chamber of Manufactures, which circulates literature, holds meetings and exhibitions, and in other ways endeavours to promote the development of South Australian manufactures and products. A book of this description is of quite as much value to the English exporter as to the intending emigrant, for a general knowledge of the countries with which one does business is of interest and service, even to the electrical man. In the classified list of imports we find that among the goods imported in 1906 and 1907 there were the following :—

	1906.	1907.
India-rubber goods	£32,825	£38,194
Iron and steel	297,239	375,689
Machinery :—Agricultural	45,181	109,499
Other	261,631	324,316
Metals, manufactures of	306,685	438,010
Tools of trade	43,515	57,465

In the exports sections the principal item of concern here is copper, nearly all other lines being agricultural and such like produce. In 1906 the copper ingots exported were 2,829 tons valued at £236,526, the figures in 1907 increasing respectively to 3,739 tons, valued at £335,579. The copper in matte in 1906 was 1,135 tons, valued at £88,314, but in 1907 it was only 233 tons valued at £22,363. In regard to the employment of the people, 49,161, or 13·57 per cent., are engaged as "primary producers," 6,301 of these, or 1·74 per cent., being engaged in mining industry. The industrial occupations employ 24,924, or 6·87 per cent., in manufacturing; 8,834, or 2·44 per cent. in building and construction, and "indefinite" accounts for a further 7,473, or 2·06 per cent. It may be interesting to mention here as indicating how wages run, the following figures prepared in September, 1908, by the Government Labour Bureau:—

Boiler makers, 10s. per day; brass finishers, 8s. 6d. to 10s. per day; coppersmiths, 9s. to 10s. per day; fitters and turners, 10s. per day; ironmoulders, 10s. per day; pattern-makers, 9s. to 10s. per day.

Reference should also be made to Mr. B. H. Morgan's report on "The Trade and Industry of Australia," (Eyre & Spottiswoode, London, 6s.), in which as a result of his tour in foreign parts as Commissioner on behalf of a home Manufacturers' Association, and of his conference with Government authorities, Chamber of Commerce representatives and others, he was enabled to bring together a large volume of information—much of it of general value for reference—on the state of, and openings for, trade, and the condition of local industries in Australia and New Zealand.

He writes that he found an "unmistakeable desire—indeed I might even say eagerness—to improve the trade relations with the Mother Country," and "leading importing and distributing houses" in the Commonwealth were "willing to give every possible information with a view to increasing British trade." Space precludes our entering upon the ground covered in any detail, but we observe that in his chapter on "British and Foreign Trading Methods," he describes the three charges of "want of enterprise," "want of adaptability," and "bad packing," levelled at the British manufacturer in British Consular reports, as being "more apparent than real," and as being "popular complaints" which have been "uttered with untiring monotony during the past decade," and which are unsupported by Consular details. Mr. Morgan "did" the Australian Commonwealth and the Dominion of Canada in a few months, leaving England in February and arriving back here again in July, 1908, and he says that he "did not find many instances of want of enterprise, want of adaptability, or bad packing" in travelling through Australia and New Zealand. May be on a flying visit he was otherwise occupied, but he does not omit to report in detail a number of "individual cases" that he came across. It may be possible to obtain a correct impression of a large part of the world in a few months, but we ourselves cannot ignore the remarks that are made to us by men hailing from countries in which they have spent years obtaining a specialised knowledge, and in this respect, whatever may be our opinion of Consular reports in general, we find that the men coming from the heart of things confirm the Consular charges of want of adaptability in meeting the general and electrical requirements of foreign markets, and want of enterprise on the part of some long-established buying houses abroad and manufacturers at home, while we have already said enough on the question of bad packing, as have also some of our contributors abroad. We would like to quote, however, the statement made to Mr. Morgan by one of the largest hardware distributing houses in Melbourne:—"American manufacturers are, as a rule, very much better packers than British." This does not look as though the utterances of "untiring monotony" were far wrong!

He quotes one testimonial to the improving packing methods of the British, and follows it with a number of cases to the opposite effect showing the superiority of American methods; one instance cited relates to a consignment of English lighting glassware, 50 per cent. of which was broken. This and other cases seem to us to provide the omission of details that the Trade Commissioner says is observed in the Consular reports. Mr. Morgan blames the shipping companies for breakages, the shipping companies retort—you must pack better.

He says "The British manufacturer is rather slow in his methods, and he will not make medium and low class goods. . . . . We undoubtedly make a mistake in sacrificing everything for quality." What is this, then, but lack of adaptability?—and lack of adaptability is more or less lack of enterprise. This, it is said, "will always tell against him in a new country where the foregoing characteristics are specially called for, as is the case in some branches of Australasian trade." Quite so, that is precisely what the Consuls have "uttered with untiring monotony." What Mr. Richard Grigg said in regard to Canada (see ELECTRICAL REVIEW, March 13th, 1908, p. 457, and July 16th, 1909, p. 94) and what Blue Book Cd. 3867 said of New Zealand (see ELECTRICAL REVIEW, June 18th, 1909, p. 990), is, we believe, worthy of close study.

The *Times* in its *Financial Supplement* recently commenced a series of articles on "British Oversea Trade." The second of these articles relates to the Australian markets, and is written by a Sydney correspondent. He says that in many lines the United Kingdom is losing ground in Australian trade, but in other lines she is maintaining or improving her position. The position of the United Kingdom is a predominant one, and the principal foreign competitors are the United States and Germany, "but even then the exports from other British possessions in 1907 to Australia, practically equalled in value those from the United States." He says, "Perhaps the best way for the foreign manufacturer to secure a footing is to introduce a novelty; he is sure to find England a slow copyist. Then, too, the Mother Country does not care for the cheap trades . . . . It is all very well to say that these cheap goods are rubbish and dearest in the end. If we want showy stuff we have to be humoured. The question of quality is our affair." The English exporter is shown to lead strongly in most metal and machinery lines, but he does not do so in, *inter alia*, lampware, electrical machinery, mining machinery. An English shopkeeper is instanced who made an effort to place business in England: "Some orders he gave were badly packed and badly executed. That, of course, is his version. But *he went to Germany and bought extensively.*"

Many British lines have preferential treatment, but "how does the foreigner obtain a footing?" Answering his own question, the *Times* writer says: "There can be no question that the foreign heavily subsidised shipping lines to Australia are a material assistance if they carry the goods very cheaply. . . . Often the foreign agent will sell without profit, or even at a loss, to secure a footing, and he will sell small lines and take much trouble with them." This very interesting article is concluded in the following terms:—

There is no doubt the Briton is often a slow competitor, and does not care to disturb his groove. He does not take a hand in the factory as he once did. But he is also handicapped by high railway freights in England, by shipping freights higher than the foreigner often pays, and by Government departments which have not the mercantile adaptability. Still, the manufacturer must learn and know for himself. In many lines the British manufacturer is quite up-to-date, and does well here. But where foreign competition succeeds there are good reasons, and they should be taken to heart. The British maker who is losing ground should come and see for himself.

These words were not written particularly concerning the electrical industry, but we earnestly urge British electrical manufacturers to indulge in a little self-examination and see whether the criticisms are in any degree deserved by them, and if they are, apply the remedy.

"Some Export Trade Humbugs."

This sub-title, to say the least of it, is expressive. It serves to warn the aspiring exporter that he must "watch out," and not be led into entrusting the interests of his firm to the first enthusiastic zealot who, with a profusion of big promises and self-advertisments, offers his services. The words formed the title of an instructive address delivered not a great while ago before the American Cotton Manufacturers' Association, by Mr. E. N. Vose, who warned his hearers against the "syndicate agent" as the commonest type of the class. We quote some extracts from Mr. Vose's address from the American *Electrical Record* for the edification and warning of British electrical exporters.

It is by no means unusual for a group of manufacturers in closely related lines, or perhaps residing in the same city or belonging to the same club, to form a little syndicate or organisation for the purpose of sending a salesman abroad to represent them all jointly.

This plan is proper and entirely practicable. The humbug who seizes upon this idea reverses it. Instead of the manufacturers who form this "syndicate" working together and hiring the foreign salesman who seems to them most capable, the agent makes his own arrangements with each manufacturer separately. Instead of confining the syndicate to four or five closely related lines—such as clocks, watches, silverware, and jewellery—he calls upon anybody he thinks he can get and cheerfully undertakes the representation of watches, steam engines, hair restorers and sulky plows, and as many other lines as he can run across. While usually asserting that he intends to have at most only 10 firms in his syndicate, the agent often secures that number in a single city and then goes on for more, telling each new victim that his firm is the last one needed to complete the enterprise. As the agent has no intention of so much as attempting to secure business for his clients, it is easy for him to make big promises. It is the folks who intend to keep their word who are hampered by having to keep within the prosaic limits of probability. The thing to do, when such syndicate agents come around is simply to put their statements to the test, insist on knowing the name of every firm composing the syndicate, investigate the agent's credentials and antecedents, and, in a word, treat the whole proposition just as you would if it related to domestic trade instead of foreign. There is no hocus-pocus about export trade that prevents the ordinary rules of business and of common sense from being applied to it.

An ingenious variation on the syndicate idea is that of the species of humbug who proposes to sell the manufacturer's goods strictly on a commission basis with a small salary to cover expenses. As the salary is to be deducted from the amount of the first order, and is not due if there are no orders forthcoming, the manufacturer considers himself quite safe in signing this contract, and cases have even been known where men who have been victimised by the syndicate game have been victimised a second time by this clever, and apparently innocent, scheme.

What happens, however, is this. The swindler disappears with his contract in his pocket, and for a year or so no more is heard of him, and he is well-nigh forgotten. Then an order is received from some distant point through his New York representative. The goods are shipped as directed, but instead of a remittance the manufacturer receives a neat little "statement" showing that his account with his forgotten "agent" stands somewhat as follows:—

To 12 months' salary at $50 per month, as per contract ..	$600
To commission on sale as 10 per cent	60
Total	$660
By merchandise, as per invoice	600
Balance still due	$60

While the cool request for another 60 dollars or so is usually ignored, the manufacturer really has no redress in a case like this. The goods are beyond recovery, and are, of course, sold before this "Statement" is ever rendered, while if the humbug were caught—which is also difficult—his "contract" would probably protect him against a criminal charge, and his utter lack of resources renders a civil suit useless. The only way to avoid such expensive experiences is to act toward such propositions as toward syndicate schemes—rigidly investigate everything, and reject absolutely those that show the slightest ground for suspicion.

The very latest wrinkle in the line of export agent humbuggery hails from Egypt, although a somewhat similar scheme has been tried elsewhere. A firm in Egypt made a contract with an American manufacturer whereby it was granted the exclusive agency of the manufacturer's goods for that country, the contract to run for two or three years unless formally terminated. As no orders were ever received, the American concern decided that its agent had gone out of business or was unable to effect any sales, and allowed some of its products to go to another Egyptian firm. The "exclusive agent" seems to have been waiting for this very thing to happen, for he immediately pounced upon the manufacturer with a suit for 50,000 fr. damages for breach of contract. The case went to the plaintiff by default, and he secured the full amount demanded and costs, together with a Court order authorising him to seize the defendant's goods or property in any part of Egypt. The result of this procedure was not so serious in point of actual loss, since the goods thus seized amounted to only a few hundred dollars in value, but this manufacturer now finds himself barred out of the Egyptian market indefinitely, while his competitors may be getting a firm foothold there. The same scheme in France or Mexico or any large buying market might result in very heavy loss both in confiscated goods and in trade. It is rarely worth while to contest such cases, since local Courts will almost invariably favour the plaintiff, and foreign lawyers are usually troublesome and expensive. It is extremely difficult to prevent a few packages of one's goods from getting into a country tied up by such an exclusive contract, even when the utmost care is taken to do so, since merchandise often travels by roundabout channels.

(*To be continued.*)

French Railways.—The eventuality of the conversion of French railways to electric traction has induced the Compagnie Thomson-Houston, of Paris, with the co-operation of the A.E.G., of Berlin, and various banks, to decide upon the formation of a company with a capital of £200,000 as a kind of trust in connection with any schemes which may be brought forward. In this way the German company hopes to secure appropriate and adequate representation when any proposals are in contemplation.

REVIEWS.

Radio-Activity and Geology. By J. J. Joly, Sc.D., F.R.S. London: Constable & Co. Price 7s. 6d. net.

This most interesting work, of some 300 pages, is an extension of Dr. Joly's presidential address to Section C of the British Association in 1908. It contains chapters dealing with radio-active measurements, together with some nine other chapters dealing with the influence of radio-activity on terrestrial history.

The "Age of the Earth" and the state of its interior is a fascinating subject for speculation. So far as the writer is aware, no one except Lord Kelvin has succeeded in giving an estimate of the earth's age, free from very grave uncertainties. The methods adopted have been (*a*) geological, based on rate of denudation of rocks, or quantity of sodium in the sea; (*b*) physical, Kelvin's method, based on the fact that the present temperature gradients are regarded as due to escaping heat from the earth's interior, the earth originally being supposed to have been in a highly heated condition.

Now, however, owing to advances in radio-active research, we have a school of scientists who ask us to believe that the earth is not necessarily a cooling body, but that its losses of heat may be made good, and even its original store of heat accounted for by the presence of radio-active substances in its constituents.

Before accepting such a doctrine it is well to look into the facts a little closely.

Uranium, the supposed parent of radium, has never been experimented upon in the laboratory. Radium has been experimented on, and it is found that its changes are independent of pressure and temperature, within the limits at our disposal. It is therefore assumed by those scientists that uranium when buried under immense depths, and at great temperatures, still behaves in the same way as it is *supposed* to behave — viz., still remains the parent of radium, and undergoes radio-active change. The radio-active changes being wholly atomic, these changes are supposed independent of external conditions of every description.

Next, the rocks containing uranium are of great density, and at first sight one would suppose that we might expect to find them concentrated at or near the centre of the earth. Observations, however, of temperature gradients reveal the fact that the radium in the earth's interior is much more sparsely distributed than on its surface, and the conclusion is arrived at that there is a layer of "radium-rich" material in the earth's surface extending to a depth of 30 miles or so. Beneath this the radium deposits are much less rich.

Further, we have in this volume an attempt to account for the observed underground temperatures in the Simplon and St. Gothard tunnels, and perhaps this is the chapter which will strike the general reader as the most unsatisfactory of the lot. In this case certain temperatures at different points in the tunnel are observed which do not at all agree with the radio-active content of the rocks (see page 86).

Of the various chapters, those on "Radio-Activity and the Interior of the Earth," and "Uranium and the Age of the Earth," seem the most interesting.

The chapter on the "Radio-Activity of the Atmosphere," discusses the presence of helium in it. As is well known, the amount of helium seems relatively enormous, and could not have accumulated in this geological epoch. It is hinted that this helium may be the accumulations of pre-geologic times, and here it seems we are in quite as bad a state as the geologist with his bank of time.

Entrancing as it may appear to account for the earth's age, &c., most of the hypotheses piled one upon the other being quite unprovable, it will, of course, be noticed that such calculations cannot possibly be regarded in the same way as, say, Lord Kelvin's estimate of the earth's age.

Nevertheless, Dr. Joly has written a delightful book, which will be welcomed by everyone interested in this latest phase of scientific progress, and the general reader, or the geologist, unacquainted with radio-active measurements, will find some explanatory chapters. There are also Mathematical Appendices at the end of the book in which the method of calculating underground temperatures due to radio-activity is simply explained.

On page 100 we notice a printers' error, "potentional" instead of "potential," otherwise the book seems quite flawless in this respect.

We cordially recommend a perusal of this work to all those interested in these "up-to-date" speculations.

Electric Railway Engineering. By H. F. PARSHALL, M.Inst.C.E. and H. M. HOBART, M.I.E.E. London: Archibald Constable & Co. Price 42s. net.

A large quarto-sized book of 450 pages, treating, in a most exhaustive manner the various problems connected with the application of electric power to heavy railway work, as distinct from tramways. It is a fine example of the printer's art, and the illustrations, curves, tabular data, &c., are presented in such a way as to make the book a most valuable one for ready reference as well as a book to read steadily through.

The subject matter is divided into three parts. The first treats of The Mechanics of Electric Traction; Tractive Resistance and Force: Acceleration; and Studies of Characteristics of Motors and Load Curves. The second part describes Generating Plant, Details of High-Tension Transmissions, Sub-Stations and the Third Rail and Overhead Wire Methods of Conveying Current to the rolling Stock. The third is concerned with rolling stock, Locomotives, Trucks, and includes a Comparison of a Single-Phase and Continuous-Current System.

The authors take a series of established facts and connect them together with subject matter written in a clear style. They have very definite opinions on a number of debateable points, and they state them in unmistakable language, where perhaps others would have written ambiguously.

Regarding the scope for railway electrification, they are of opinion that the field, at present, is on urban and suburban lines. They admit straight away that, except in the case of exceedingly dense and steady traffic, the cost of working by electricity will, apparently for a long time to come, be greater than that of working by steam.

Many electrical engineers, and especially those few who, like the writer, have served their engineering apprenticeship in a locomotive-manufacturing works, will be able to subscribe to the authors' reference to the excellencies of the steam locomotive. They say, "In the application of electricity to long-distance lines, it is to be steadily borne in mind that the steam locomotive has demonstrated itself to be the most efficient self-contained machine, considering its varying functions, that the engineer has yet devised. To compete with this machine, every appliance entering into the electric traction installation must compare from every point of view as regards efficiency with this most highly-developed and perfect mechanism."

Standardisation has been one of the great elements of success in steam railway working, and the future growth of electric traction will be slow until the standardisation phase has been reached. At the present time there exists a wide difference of opinion among engineers regarding the commercial advantages of alternating and continuous-current motors for traction. The authors make it quite clear that they do not favour the single-phase system, and they say "we are satisfied that a careful comparison of the two types at the present time is decidedly to the advantage of the high-tension continuous-current motor."

Acceleration is very exhaustively dealt with, the separate sets of curves in this chapter alone numbering over 200. One set of curves shows the limits of attainable *average* and *schedule* speeds. Thus, for a 1-mile run between stops, an average speed of 45 miles an hour is practically unattainable. Such an average speed with one stop per mile, and a duration of 20 seconds per stop, involves a total of

$$\frac{45 \times 20}{60} = 15 \text{ minutes}$$

out of every hour during which the train is at rest. The corresponding schedule speed is therefore—

$$\frac{60 - 15}{60} \times 45 = 33{\cdot}8 \text{ miles per hour.}$$

In practice a schedule speed of 30 miles an hour represents the upper commercial limit.

The accelerating gradients of the Central London Railway contribute as much as one-fourth of the energy supplied to the train, and similar retarding gradients assist the brakes when stopping.

Table XII is important, because it gives the recoverable energy per ton-mile in percentage of total energy expended at axles per two-mile run from start to stop, and with an average speed of 30 miles an hour. If the maximum speed at completion of acceleration is 60 miles, the recoverable energy is 70 per cent., whereas with maximum speeds of 35 and 31 miles it is 50 per cent. and 48 per cent. respectively.

From their own tests the authors say that for relatively low schedule speeds and infrequent stops the advantage of employing regenerative control is very slight. On the other hand, a high schedule speed with frequent stops permits of much greater advantages than is generally realised. They give a practical case where it works out at 25 per cent. of the energy input to the train.

The largest chapter in the book deals with characteristics of electric railway motors, and if there is anything more to say on the subject than the authors have stated, then it must surely deal with the colour and thickness of the paint. There are over 100 curves in this chapter and 22 tables. Table XX gives some excellent information regarding five alternate methods of motor control. Parallel control gives an efficiency, during the period of acceleration, of 42 per cent., and series-parallel control, with an infinite number of steps, can only attain to 65 per cent.

Discussing the question of steam prime movers, the authors thus sum up the matter. For a large installation with large units a slow-speed engine or steam turbine would be more suitable than a high-speed reciprocating engine. The former should be used if the facilities for condensing are limited, and the turbine if there is abundance of condensing water at a convenient level not involving much extra power in lifting. In the case of a small installation, where the size of the units is under, say, 500 KW., the high-speed reciprocating set would be found more suitable than a slow-speed set; and if the condensing facilities are limited a steam turbine is out of the question as against a high-speed set.

A noteworthy feature of this chapter on generating plant is the tabular data of overall thermal efficiency of power plant. Table XLI shows the possible commercial efficiency of a steam plant, varying with size of unit and load-factor, and the values given are such as the station engineer should obtain, provided he has all the advantages of superheat, ample condensing water, pressure, &c. If any specific advantage is absent, such, for instance, as superheat, or if the station is placed so that the amount of condensing water is limited, or if it has to be lifted to a considerable height, then the value of such deficiency can be readily calculated, and the necessary corrective can be applied to the figures in the table.

The chapter on the distributing system contains an amount of practical information, the preparation of which must have involved considerable research and experiment. Table LXXVI, for example, gives the dip and span of suspension cables for different ranges of temperature. Also, on page 270, there is valuable data on the resistance of steel rails, according to the amount of carbon, manganese, silicon, phosphorus and sulphur present. Table LXXXII gives the resistance, reactance and impedance of bull-head steel rails, and a very important table, LXXXVII, gives the total impedance per mile of circuit, consisting of overhead conductor and rail return. Leakage from track rails is also exhaustively dealt with, and it is a matter likely to assume some importance if single-phase traction comes to be adopted.

Needless to say, all the leading electric railways in the world are described, or reference made to their principal features. The authors have most to say about continuous-current railways, but that is natural, as the majority of railways are worked on that system. The advocates of single and three-phase railways have, however, nothing to complain of in the way such railways are dealt with. Whatever be the merits of the various systems, this book places on record in a handy form, the details of much fine original engineering work carried out by electrical engineers during the last 10 years. It is a record the profession, throughout the world, has every reason to be proud of. E. K. S.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

FRANCE—FRENCH WEST AFRICA.—In the French possessions in West Africa situated outside the zone dealt with in the Treaty of 1898 with the United Kingdom—that is to say, in Senegal, French Guinea, Upper Senegal, Niger and Mauretaine—a duty of 12 per cent. *ad valorem* is levied on electrical and similar goods. In the other French possessions in West Africa—viz., the Ivory Coast and Dahomey—the duty is 10 per cent. *ad valorem*. The value on which duty is calculated is the value of the goods at the place of importation, as fixed by the official at the port of importation, or the value as shown by the invoice and increased by 25 per cent.

GAMBIA.—The following goods are admitted free of duty:—Machines for industrial purposes; mills for grinding, sawing, raising water, or any such as are set in motion by electricity, steam, horse, wind or water power, and all parts of the said mills; pipes; scientific instruments and apparatus; steam engines or any part of a steam engine; articles of every description imported for the use of the Colonial Government; all *bona fide* telegraph materials landed for the use of the African Direct Telegraph Co.

Electrical and similar goods not specially mentioned are dutiable in general at the rate of 5 per cent. *ad valorem*.

The value of goods liable to *ad valorem* duty is to be taken as the invoice value, less trade discount, freight, insurance, and value of packages.

NEW PATENTS APPLIED FOR, 1909.

(NOT YET PUBLISHED.)

Compiled expresaly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

18,310. "Improvements in electric advertising signs." H. H. Clements. August 9th.

18,326. "Improvements in switch plugs for telephone exchanges." Siemens Bros. & Co., Ltd. (Application for patent of addition to No. 9,592, 1909. August 9th.) (Complete).

18,328. "Improvements in flame arc electric lamps." Siemens Schuckertwerke G.m.b.H. (Date applied for under Sec. 91 of the Act, August 11th, 1908, being date of application in Germany.) August 9th. (Complete.)

18,366. "Improvements in or relating to what is known as photo-telegraphy." T. T. Baker. August 9th.

18,402. "Improvements in telephonic transmitters or microphones." G. A. Nussbaum. August 10th.

18,405. "Improvements in electric clocks." F. Hope-Jones. August 10th.

18,409. "Improvements in and relating to electric insoles for shoes, boots and the like." O. Rampelbergh. August 10th. (Complete.)

18,420. "Improvements relating to magnetic separators." A. P. Hutchinson. August 10th.

18,433. "Improvements in the electro-chemical production of phosphatic fertilisers." G. Levi. August 10th.

18,436. "Improvements in or relating to wireless telegraphy." V. Colin and M. Jeance. (Date applied for under Sec. 91 of the Act, April 17th, 1909, being date of application in France.) August 10th. (Complete.)

18,449. "Improvements relating to the parallel driving of electric generators and prime movers." D. Roberts, A. R. Bellamy and C. James. August 10th.

18,456. "Improvements in telephone exchanges." Siemens & Halske Akt.-Ges. (Date applied for under Sec. 91 of the Act, October 2nd, 1908, being date of application in Germany.) August 10th. (Complete.)

18,457. "Improvements in ignition devices for internal combustion engines." R. Bosch. (Application for patent of addition to No. 26,435/07. Date applied for under Sec. 91 of the Act, September 17th, 1908, being date of application in Germany.) August 10th. (Complete.)

18,469. "Improvements in and or connected with electrodes for arc lamps." F. M. Lewis. August 10th.

18,471. "Improvements in electrical switches." J. H. Tucker. August 11th.

18,484. "Improvements in balancers, auto-transformers and boosters on direct current system." A. M. Taylor. August 11th.

18,499. "Improvements in electric traction." E. G. Pink. August 11th.

18,500. "Electric circuit closer for use with railway switch points, point locks, signals, train stops, gates and the like." A. H. Johnson. (Date applied for under Rule 13, December 18th, 1908. An invention comprised in application No. 27,554, dated December 18th, 1908.) August 11th.

18,511. "Electric burner for heating water to produce superheated and ordinary steam for motor cars of all descriptions and motor boats." G. E. A. Holdsworth. August 11th.

18,522. "Improvements in or relating to systems for telegraphy and telephony." J. Perry and S. G. Brown. August 11th.

18,524. "Improvements in transmitting apparatus for wireless telegraphy." G. Marconi and Marconi's Wireless Telegraph Co.

18,534. "Multiple distribution for ignition apparatus." Firm R. Bosch. (Date applied for under Sec. 91 of the Act, July 20th, 1909, being date of application in Germany.) August 11th. (Complete.)

18,583. "Improvements in and relating to electric mechanism for writing and colour changing signs." R. F. Venner and R. C. Griesbach. August 12th.

18,590. "Means for preserving or protecting the lead supports of the positive electrodes of secondary or storage batteries from peroxidation." P. Marino. August 12th. (Complete.)

18,594. "Improvements in or relating to communicators for dynamo-electric machines." P. A. Lange. August 12th.

18,624. "Improvements relating to electrical devices for controlling movements from a distance." P. Vieu. (Date applied for under Sec. 91 of the Act, August 14th, 1908, being date of application in France.) August 12th. (Complete.)

18,636. "Improvements in arrangements for charging and discharging accumulators or secondary batteries." A. M. Taylor. August 13th.

18,665. "Improvements in switch mechanism for small electric lighting installations." C. A. Vandervell and A. H. Midgley. August 13th. Complete.)

18,675. "Improved automatic switch gear for the remote control of electric motors." M. T. Medway and M. D. Scott. August 13th.

18,687. "Improved switch for controlling electrical circuits." T. J. Rorke and E. Rorke. August 13th. (Complete.)

18,690. "Improvements in and relating to insulators for telegraph, telephone and like wires." A. M. Bourke. August 13th. (Complete.)

18,691. "Improvements in and relating to counting trains for electricity meters and the like." W. Hamilton and Ferranti, Ltd. August 13th.

18,755. "Improvements in electrical timing mechanism for clocks and the like." F. H. M. Thomas. August 14th.

18,756. "Improvements in or relating to electric lamps and galvanic batteries." F. J. Turquand and W. A. Turquand. August 14th.

18,758. "Improvements in means for regulating the sensitiveness of the tripping devices employed in connection with the automatic operation of electrical switches." P. Hero. August 14th.

18,771. "Improvements in or relating to electrical or electrically-operated fire alarms." W. Leake and A. V. Rushworth. August 14th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Electricity Meters and other Measuring Instruments. G. Hookham. 15,802. July 25th. (Cognate application No. 219/09.)

Soundproof Box for Telephones and other Purposes. W. H. Colwill and H. Horswell. 16,755. August 10th.

Telephone Exchange Systems and Apparatus Therefor. J. E. Kingsbury. (Western Electric Co.) 17,209. August 15th.

Packing Incandescent Electric Lamps. M. I. Cooper. 17,978. August 27th.

Regulation of the Speed of Electric Motors. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke Ges.) 18,017. August 27th.

Three-Wire Telephone Systems. F. J. Dommerque. 18,039. August 27th.

Electric Starting Switches using Liquid Resistance. Sandycroft Foundry Co. and T. M. Dutton. 18,623. September 4th.

Electrical Ignition Devices. E. Denieport. 18,811. September 8th.

Electrical Driving Gear. G. F. O. Pollet. 22,377. October 21st.

Means for Holding Globes or Shades in the Galleries of Electric Light, Gas and other Fittings. Falk. 22,964. October 28th.

Manufacture of Electric Conductors. P. McGahan. 23,007. October 29th. (Date applied for under International Convention, November 8th, 1907.)

Brush Gear for Dynamo-Electric Machinery. P. L. R. Fraser and Tudor Accumulator Co.) 23,709. November 5th.

Intercommunication Telephone Systems. G. Burney and J. Brinkmann. 25,446. November 25th. (Application for Patent of Addition to No. 21,995/04.)

Shade Devices for Incandescent Electric Lamps. C. W. Frauenlor. 27,523. December 18th.

1909.

Instruments for Measuring the Decrement of Electromagnetic Oscillations. Marconi's Wireless Telegraph Co. and H. J. Round. 195. January 4th.

Alternating-Current Magnets for Resonance Apparatus. G. G. M. Hardingham. (Hartmann & Braun Akt.-Ges.) 2,016. January 27th.

Ignition Indicator for a Multi-Cylinder Internal-Combustion Engine, Particularly for Motor-Cars. H. H. Mattonet. 3,403. February 11th.

Switchboard Equipments for Telephone Exchanges. F. F. V. Johannsen. 3,539. February 12th.

Directed Wireless Telegraphy. E. Bellini and A. Tosi. 4,831. February 26th. (Date applied for under International Convention, March 7th, 1908.)

Wireless Telegraphy. S. Eisenstein. 5,578. March 8th. (Application for Patent of Addition to No. 10,019/08.)

Friction Couplings Adapted for Use with Electromotors for Driving Machine Tools and the like. P. M. Justice. (Soc. Anon. Electricité Electromecanique.) 6,850. March 22nd.

Electric Induction Furnaces. Gröndal Kjellin Co. and J. Härden. 8,194. April 5th.

Polarised Morse Sounders and Ink Writers. C. C. Vyle. 8,533. April 8th.

Electrically-Operated Cranes, Lifts and the like. Allgemeine Elektricitäts Ges. 8,456. April 7th. (Date applied for under International Convention, April 8th, 1908.) (Application for Patent of Addition to No. 17,622/08.)

Wireless Telegraphy in China.—A Shanghai correspondent of a German newspaper reports that a wireless telegraph installation was recently erected on the new building of the English Palace Hotel in that city, for the purpose of establishing communication with incoming and outgoing ships *via* Wasung. Immediately on the apparatus being brought into use, on the opening of the new hotel in July, the Chinese Government lodged a protest against it on the ground that wireless telegraphy was a State monopoly which could not be granted to private individuals. The owners of the hotel, and the British authorities on their behalf, sought to maintain the British claim, but they finally had to give way after the Government expressed readiness to buy and remove the installation. The objections of the Chinese are explained, the correspondent states, by the experiments which the Government recently made with systems of wireless telegraphy, and by the value which would be attached to an extension of such a network throughout that enormous empire. Owing to the great distances the existing overland telegraphs are worked at great cost, especially as they are almost exclusively carried along the river valleys and are subject to constant floods and breakages, whilst the wires in various districts have to be guarded by military in consequence of the attitude of the population. In the circumstances, the introduction of a State system of wireless telegraphy would be of extraordinary value to China, and this belief led to the experiments already mentioned. It is said that a German system has proved to be the best, and has the most prospect of being introduced in China.